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DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

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THE RECENTLY FOUND RHODESIAN SKULL

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DISCOVERY. A Monthly Popular Journal of Knowledge.

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Editorial Notes

WITH this number our journal enters upon its third year. The fact that it has survived the lapse of two difficult years, in which many sections of our community have found it necessary to abandon magazine-buying as an unpermissible luxury, and has found a wide and permanent reading-public, speaks for itself. There is obviously room for a magazine that attempts to keep abreast of contemporary developments and discoveries in the ever-increasing spheres of human activity and intellectual endeavour. In these the year 1921 has, indeed, been very rich.

* * * * *

Apart from advances in scientific knowledge, an event occurred towards the end of last year which is likely so to affect the year 1922 and, in fact, the whole of the twentieth century, that we cannot afford to disregard it in our pages. This was the opening of the Disarmament Conference at Washington. Whether this conference succeeds or fails, it will have expressed in a very forcible way the tendencies in international desires matured by the late war. If it fails or only succeeds partially, its expression of an intense popular feeling will have a marked influence on the thought and activities not only of our generation, but of many subsequent ones. If it succeeds, and an honest collaboration in following the paths of peace ensues, the spirit

of internationalism will grow apace, and a great flood of human energy and financial resources will gradually be diverted from destructive into constructive channels. Of vast importance, too, to our own Empire is the agreement between the United Kingdom and Ireland. Both events should greatly assist in re-establishing our prosperity and, what comes particularly near to the hearts of the readers and writers of DISCOVERY, in ushering in a year of renewed progress in the arts and sciences, and their application to life.

* * * * *

From the amount of correspondence that reached the Editor's table as the result of Professor Douglas Knoop's article in our November number, it is obvious how great a diversity of thought has been roused by the problem of unemployment. While keeping our correspondence column open to all shades of opinion on the question, we do not intend to pronounce any judgment on it in these notes. At the same time, we cannot refrain from calling our readers' attention to the extremely interesting and largely successful methods that are being employed to combat the difficulty in Germany. The most important feature of the complicated system, which Germany has put into force, is that of the *Umschulung*. A detailed description of it appeared in *The Nation and the Athenæum* on November 5 of last year. We have not space to do more than outline it here.

* * * * *

The *Umschulung*—the industrial training of adults—was instituted by a decree of the *Reichsarbeitsministerium* of April 9, 1920. Though it has had to be both modified and amplified by various circumstances, its general methods have remained the same. Its purpose in the main is to transfer workers from overcrowded or obsolescent industries to those in need of employees, and at the same time to supply the necessary financial assistance to employers and employed during the period of transfer. So far as the individual worker is concerned, it guarantees to train any worker of good character, who has been thrown out of employment through no fault of his own, in a trade in which workers are in greater demand. The training allowance,

of which one-sixth of the cost is borne by the municipality, two-sixths by the State, and three-sixths by the *Reich*, is paid to the business concern in which he is apprenticed for the purpose of learning his new trade. The concern has to pay him a fixed sum, usually two-thirds of the trade union standard wage, so long as he is below the average in proficiency at his trade, however unproductive he may remain during the first weeks. At first sight it would appear that all kinds of disadvantages would accrue to both employers and employed, but the whole scheme is too carefully supervised by Training Committees composed equally of employers and trade union representatives, by the Works Councils and by the local employment exchanges, to admit such possibilities. Nearly all workers remain in the concerns to which they were originally apprenticed under the scheme.

Apart from individual cases, training on a *wholesale* scale for new projects is carried out on these lines. This is only one of a number of measures for relieving unemployment. Its purely practical advantages over the dole system are obvious; it puts the taxpayers' and ratepayers' money to a profitable use; it provides the unemployed workers with the knowledge of a craft, and in many cases of an extra craft; it keeps a full store of skilled men against a sudden boom in trade.

Contributors to this Number

MR. E. N. FALLAIZE is the Hon. Secretary of the Royal Anthropological Institute. Amongst many other activities in the sphere of anthropological research, he has acted as the Recorder of the Anthropology Section of the British Association since 1906, and has contributed extensively to the literature of his science. During the war he served with the infantry in the Salonica forces. At the Bulgarian Armistice he was on the Intelligence Staff at G.H.Q. in Salonica, and after its conclusion proceeded to Constantinople.

MR. J. U. POWELL is the Senior Tutor of St. John Baptist College, Oxford University. A long period of research in Greek history and literature of the fourth and immediately subsequent centuries B.C. has led to his editing in company with Mr. E. A. Barber, and largely writing, *New Chapters in the History of Greek Literature*, published in the autumn of last year.

PROFESSOR F. E. WEISS is the Harrison Professor of Botany at Manchester University. Amongst the many important positions which he has held at that University has been that of the Vice-Chancellorship, 1913-15. He is fond of the practical side of gardening, and is a mountain-climber.

MR. F. A. HAMPTON was appointed a Lecturer in Physiology at Oxford University in 1914. He was unable to take up his duties owing to the outbreak of war, during which he served from 1914 to the Armistice on the Western Front as medical officer in various cavalry, infantry and air force units, gaining the Military Cross. His first-hand knowledge of the effects of fighting on the nervous system was employed after the Armistice at one of our largest hospitals for the treatment of shell-shock. He is now engaged in the treatment of nervous diseases.

MR. ARTHUR BOWES acted for many years as municipal engineer to the local authorities of Salford and Newton-in-Makerfield. In 1891 he was elected an Associate Member of

the Institution of Civil Engineers. He has written widely on engineering and architectural subjects, and recently on lighter subjects of a literary nature.

MR. ROWLANDS COLDICOTT, who concludes his notes on Dr. Wolcot, spent several years of research on his subject at Durham and Oxford Universities before the war. During the war he served with the infantry in France, Salonica, and Palestine. In the advance to Jerusalem he gained the Military Cross, was shot through the lungs a few weeks later on the Mount of Olives, but made a miraculous recovery. At the Armistice he was acting as Education Officer to the cavalry in Belgium. His war book, *London Men in Palestine*, attained a deserved success.

The Rhodesian Skull and the Antiquity of Man

By E. N. Fallaize

Hon. Secretary, Royal Anthropological Institute

CONSIDERABLE interest has been aroused by the announcement made early in November that a human skull of extremely primitive type had been discovered in the Broken Hill Mine in Northern Rhodesia. This skull has now been presented to the Natural History Museum, South Kensington, and has been exhibited by Dr. A. Smith Woodward at a meeting of the Zoological Society held on November 23. Although when exhibited it had not been subjected to that detailed measurement which will be necessary before it can be compared exactly with other types of skulls, it is still possible to indicate its more salient characteristics and to suggest tentatively certain conclusions as to its place in the scale of human development. At the same time, a word of caution is necessary. Past experience has shown that too much insistence cannot be laid upon the conditions of the discovery, and in this case such warning is especially necessary in view of the currency which has been given to claims for a high antiquity for this skull without adequate mention of the qualifications to which those claims are subject. A brief recapitulation of the facts will, therefore, not be out of place.

The skull was found at the end of a cave which was being excavated for sulphates of zinc and lead. The floor of the cave was composed of fossilised bones of mammals, both large and small, including the remains of elephants, leopards, rhinoceroses, hippopotami, lions, antelopes, etc., and also birds and bats. Of these, there were indications that some had formed the food of hyenas and of man. The skull was found after the removal of some hundreds of tons of these bones. When its possible importance was realised, a further search was made and other human remains were found, including part of a jaw, part of a sacrum or hip-bone, and parts of the long bones (both femur and tibia). The

remains were found at a depth of 60 feet below water level, and 90 feet below ground level. In this connection two points are worthy of note. In the first place, the summit of the kopje, which originally covered the site before mining operations were begun, showed, at its highest point, signs of a subsidence in the shape of a shallow depression; and secondly, over the human remains was a fissure which at some time had communicated with the surface.

The skull is in a remarkably good state of preservation, and very fresh in appearance. It is complete and is only very slightly mineralised; this, in view of the condition of the mammalian remains with which it was associated, is in itself a remarkable fact. Its more primitive characteristics are at once evident to the observer. These are the extreme prominence of the eyebrow ridges and their marked lateral extension, the projection of the lower part of the face, and the length of the face as compared with that of the modern type of skull. Owing to the projection of the eyebrow ridges, the upper part of the skull has an ape-like appearance of flatness. The whole character of the face, in fact, is remarkably ape-like and, as Professor Elliot Smith has suggested, when clothed with flesh it was probably even nearer to the facial aspect of the gorilla owing to the splaying of the flat nostrils. Another ape-like character was a great thickening of the muscles of the neck as indicated by the deep impressions at the base of the skull.

On the other hand, Dr. Smith Woodward, in describing the skull, called attention to certain features in which it displays the characteristics of modern man. The brain case is modern in type and its thickness is not greater than in modern man. Its capacity, so far as can be judged without accurate measurement, is well above the lower level of the modern type. The upper jaw is perfectly human; the skull has a well-domed palate and the teeth are human and not simian. The jaw is of remarkable size. Unfortunately, the lower jaw is missing, but, as Dr. Smith Woodward has demonstrated by means of a model, even the massive Heidelberg jaw is not large enough to fit the upper jaw of this skull. In another respect this skull is strikingly modern. The *foramen magnum*, the aperture by which the spinal cord enters the skull, is centrally situated, whereas in the apes and in primitive types of skulls it is situated nearer to the back of the skull, giving the head a forward carriage. Rhodesian man's head was balanced in a perfectly upright position on the trunk.

The teeth are in an extremely bad condition. Not only are they very much worn, as in all primitive skulls,

but in addition to the traces of abscesses, caries is present in the teeth themselves. This is a condition not hitherto found in any primitive skull, the earliest cases previously known having been found in Egypt and dating from the time of the Pyramids.

The long bones are also modern in character and indicate that the individual to whom they belonged was tall and walked upright, while Professor Elliot Smith is of the opinion that the fragment of the sacrum indicates the female sex.

From this brief description of the salient features of the Rhodesian skull, it is evident that it presents certain very remarkable and contradictory characteristics. It



SKULL OF THE RHODESIAN MAN.

appears to combine ape-like and modern elements in a manner and a degree exhibited by no other known skull. In this respect alone it bids fair to provide material for controversy for some time to come. For the adequate discussion of these problems, however, more accurate examination at the hands of the expert must be awaited. At present the chief interest of the discovery lies in the light which, at first sight, it appears likely to throw upon the antiquity and evolution of man. Yet at the moment, as has already been said, any suggestion must be taken as tentative and as indicative of the points to which investigation should be directed, rather than as providing any definite advance towards a solution of these problems.

In order to understand clearly the bearing of an inquiry into the antiquity of any particular find of human remains, it should be borne in mind that the evidence of age may be drawn from one or more of several sources. The evidence may be geological, the geological stratum in which the remains are found

belonging to some horizon to which the geologist is able to assign a more or less definite date; or, when animal remains are associated with the human remains, the palæontologist may be called in to state whether the remains belong to an existing or extinct species, and if the latter, to what date or geological epoch they may be referred, as, for instance, in the case of the mammoth, the cave bear, and the like. Again, the evidence may be purely archaeological; with the human remains may be grave furniture, pottery, or other articles of human manufacture, known from other sources to belong to a certain period, era, or age. Finally, there is the class of evidence afforded by the morphology of the remains, whether used in conjunction with other evidence or, as sometimes happens, as the only available source of information: the anthropologist, by careful examination and measurement, is able to refer them to a known type, or, as in such a case as the present, to suggest a relation to a known type. This relation may be either a relation in time—that is, a stage in evolution—or simply a place in a logical scheme of classification.

In view of the fact that it has been suggested that the Rhodesian skull may date back to even a hundred thousand years, it is particularly important that the nature of the evidence requisite to the support of such a claim should be clearly understood. It may be said at once that in so far as the information at present available goes, of the four classes of evidence enumerated, three furnish no assistance towards deciding the question of the antiquity of the Rhodesian skull. A similar find in Europe might be assigned to a datable epoch, such as the Pleistocene to which Palæolithic man in Europe belongs. Our knowledge of recent geology in South Africa does not warrant a correlation with the Pleistocene in Europe. Further, the existence of the fissure in the cave, to which reference has been made, opens the way to a suggestion that the remains may have been deposited comparatively recently in the position in which they were found. This vitiates any argument based upon the "hundreds of tons of bones" removed before the remains were brought to light. Further, these bones themselves are the remains of animals which are "recent" and do not include extinct types of high antiquity. Nor is any archaeological evidence forthcoming, the only object said to be associated with the remains being a round stone similar to those used by the present-day natives for crushing grain.

In default, at present, of other data, it is necessary, therefore, to fall back upon the evidence furnished by the remains themselves. And here we are at once confronted by the contradictory characteristics upon which stress has already been laid. The gorilla-like face at once suggests a comparison with the oldest remains we know, those of *Pithecanthropus erectus*, consisting of a skull-cap and thigh bone found in Java

in 1892, which exhibit, as the name suggests, a combination of affinity with man and ape, but belong to neither. The eyebrow ridges in Rhodesian man are even more prominent than in *Pithecanthropus*. Of other early remains available for comparison, there are the Heidelberg jaw, to which reference has been made, the Piltdown skull, itself a subject of controversy, and Neanderthal man, a type to which belongs a number of human remains of the Palæolithic age representing a race or possibly closely allied group of races who lived in Europe in rock shelters and caves during the last great extension southward of the ice sheet, and produced the flint implements known as Mousterian. To this group belong the Neanderthal skull, the Gibraltar skull, and a number of skulls found in France, Belgium, Germany, and as far East as Croatia. It is to this last-named group, which was superseded in Europe by the modern type of man, that Rhodesian man presents a close affinity, particularly in the prominent eyebrow ridges and the projection of the lower part of the face, both characteristics, however, being less marked in Neanderthal man. So far as the ape-like characteristics of Rhodesian man are in question, he would appear to stand somewhere between Neanderthal man and the gorilla. On this ground, then, it might be thought justifiable to place Rhodesian man in some epoch precedent to that of Neanderthal man, for whom a date of something like 50,000 years ago is generally accepted. On the other hand, the modern characteristics of the skull appear to preclude the attribution of such a high antiquity. Further, if the remains of the long bones belong to the skull, an assumption also made in the case of the fragment of sacrum, Rhodesian man walked upright in the posture of modern man, while Neanderthal man, on the evidence of his long bones, walked with a crouch. The probability would, therefore, lie on the side of Dr. Smith Woodward's conclusion that Rhodesian man represents a later development of the Neanderthal type, and that the incongruous combination of extremely primitive and modern characteristics is to be explained by Professor Elliot Smith's suggestion that in the course of evolution the last stage was the refinement of the face.

It would, therefore, appear that, so far as the investigation has gone, there is little evidence which would assist in giving a date to these remains, while the well-preserved character and comparative freshness of the bones yet remains to be explained. Our knowledge of the greater part of Africa, from the point of view of the history of human types, is negligible, and there is no reason to suppose that a primitive form of man might not have survived there into comparatively recent times.

I am greatly indebted to Dr. A. Smith Woodward for having most kindly supplied a photograph of the skull to illustrate this article.—E. N. F.

Helicopter Flying Machines

By "Rafex"

THE aeroplane is the only heavier-than-air machine which has reached a practical stage of development at the present time. Yet there are two other forms which have been experimented with at different times, and are still the subject of research. One, the Ornithopter, has a flapping-wing mechanism intended to be a close representative of the flight of a bird; the other, the Helicopter, is able to rise into the air directly from the vertical downward thrust of a helical screw revolving in a horizontal plane. The helicopter is the subject of the present article. It has lately aroused a revival of interest owing to the zealous work of several enthusiasts, some of whom have met with partial success. Until a few years ago its possibilities had been overshadowed by the achievements of the aeroplane, and indeed it had become difficult to realise that for many decades, if not centuries, the devotees of the heavier-than-air school had been divided into three sects, followers of the aeroplane, the ornithopter, and the helicopter, so far had the aeroplane outstripped the two others in practical results.

It may be asked, and somewhat pertinently, why, in view of the success of the aeroplane, anyone still continues in the endeavour to produce a practicable helicopter, since the aeroplane appears to fulfil all requirements. The answer is to be found partly in the native pertinacity of the human mind, particularly when of an inventive turn, in its refusal to desert a thing in which faith has once been put, and its glorious determination to overcome the obstacles to the solution of a problem once set; partly in the fact that the aeroplane does not in all respects satisfy the requirements of heavier-than-air flight. The chief point in which the aeroplane fails is that it does not bring aerial locomotion to the ordinary man's door. It is, in fact, more closely analogous to the train than to the motor-car, because it is necessary to travel by some other means of locomotion in order to reach the aeroplane's point of departure. (In parenthesis, it may be noted that if this comparison between the aeroplane and the train be true, the airship appears to be the equivalent of the steamship in its capacity to extend from continent to continent the trans-continental internal transport services provided by the aeroplane.) But why can an aeroplane not start at one's door? Simply because it requires an aerodrome of considerable extent over which to run as a land-borne machine before it takes or leaves the air. It is not even in as favourable a position as a railway train, as the space required for an aerodrome

is greater than that required by a railway station, and cannot be provided within the precincts of a town. Before a journey by aeroplane can be commenced, it is therefore necessary to undertake a journey of, in most cases, some miles from one's own front door to the aerodrome; and it is this disadvantage which is seized upon by the helicopter enthusiast as the justification for his continued efforts. His point is that the helicopter could start from the roof of a house or any convenient flat space, in the very centre of a town if need be, and so combine the functions of train and motor-car. It is mainly this feature which spurs the inventor to persevere in his efforts.

The history of the helicopter is at least as old as that of the aeroplane, and, in fact, if models be considered, it may even be said that the helicopter achieved success, first, because many model helicopters of a toy form had risen into the air long before the first model aeroplane left the ground. In 1784, for example, two Frenchmen named Launoy and Bienvenu exhibited to the Académie des Sciences a primitive model helicopter which consisted of two four-bladed feather "screws" placed one above the other and caused to rotate by the untwining of a bow-string twisted round the connecting stick. In a famous paper contributed to *Nicholson's Journal* in 1809, and subsequently reprinted on two occasions by the Aeronautical Society, Sir George Cayley described the method of making a toy of this sort, which he called a "Chinese top." Incidentally, it may be mentioned that Sir George Cayley has frequently been described as the "Father of British Aeronautics," and, in fact, the papers contributed by him to *Nicholson's Journal* and the *Mechanic's Magazine* contain all the essential principles of both heavier- and lighter-than-air flight. His foresight was amazing, and there seems little reason to doubt that, had the petrol engine existed in his day, he would have succeeded in producing both a navigable airship and an aeroplane capable of flight. He was born in 1773, and, as he mentions in his paper of 1809 referred to above, his first aeronautical experiment was made in 1796 with the toy helicopter, and he was still writing on the subject of aeronautics up to a year or two before his death in 1857. Indeed, in a letter dated 1854 to Deplus Delcourt, secretary of the Société Aérostatique et Météorologique de France, he gives a description, accompanied by a rough sketch, of an improvement on "the clumsy structure of the toy called the Chinese top," produced by "Mr. Cooper of the London University," which he was "mounting, say, 20 or 25 feet." He goes on to state that he himself had had a still better model made of which he says: "It is the best I have ever seen, and will mount upward of 90 feet into the air." This consisted of three blades of sheet-tin, mounted on a box-wood nut, which was threaded

inside to fit on a threaded shaft. The shaft was revolved "like the common humming-top" by means of a cord wound round it, when the "helicopter" flew off into the air. This form of toy used to be a common object of the nursery. All Sir George Cayley's writings are extraordinarily interesting even at the present day, and he remains probably the only person in the history of the world who has ever explored the possibilities not only of airships and aeroplanes, but of helicopters and ornithopters as well.

It is impossible in a brief review of the development of the helicopter to mention any except a very few of the long line of experiments in this branch of flying, but no account would be complete without reference to some of the more notable of them. Coming to the twentieth century, one of the outstanding names is that of Louis Bréquet, mainly because he has since achieved fame as a designer of aeroplanes. His helicopter, which was built about 1908, was different from most if not all others, in being combined with an aeroplane. It consisted of a large biplane on the outer interplane struts of which a curious helicopter screw, the construction of which is somewhat difficult to describe, was fitted at each wing-tip. Each of these screws was really composed of four small sets of biplane wings at the extremities of two arms at right angles to each other, and mounted at their intersection on a circular frame, driven by gearing from the central engine. The Bréquet-Richet biplane-helicopter, as it was called, was certainly quite different from any other, and looking at it again in the light of M. Bréquet's subsequent career, it is not difficult to understand that from it should have been evolved the biplanes which are now so well known, as the machine was undoubtedly more of an aeroplane than a helicopter, the latter part of the design appearing more or less auxiliary to the former. Another helicopter of the same period, designed by M. Bertin, was unique in that the two superposed lifting screws, revolving in opposite directions—a common feature in helicopter design—were of quite different form and construction. The upper one, which was driven direct from the 50 h.p. engine, was of a metal type of construction common at that date, and had a diameter of about 10 feet. The lower one, on the other hand, which was carried on this same axis, was considerably geared-down, being designed to run at a very slow rate of revolution, and was composed of two monoplane wings mounted at each extremity of a horizontal arm, the total diameter being rather over 25 feet. A third interesting direct-lift machine of the first decade of the century was also designed by a Frenchman—M. Cornu. The pilot of this machine sat in a tubular steel framework, supported on four bicycle wheels, with the engine in front of him. Carried on steel tube outriggers running fore and aft from this

frame were two large belt-driven pulleys with vertical axis. Mounted on the periphery of each of these pulleys were two fabric-covered monoplane surfaces, the angle of which to the plane of rotation could be altered at the will of the pilot. In addition to these, a rudder and elevator were fitted in front and rear respectively, though how these were expected to act is not quite clear.

From the purely theoretical standpoint, present-day knowledge of the principles of helicopters in regard to lifting force available and the possibilities of safe descent in case of engine failure is probably due to Colonel Rénard, for many years the head of the French Government's aeronautical experimental station at Chalais-Meudon, more than to any other person. This officer spent eighteen years on exhaustive researches into the question of lifting screws, obtaining measurements by means of aerodynamic balances, as a result of which he was able in 1903 to read three papers on the subject before the Académie des Sciences, which still remain the classic literature of the subject.

It is in fact now, one will not say easy, but well within the capacity of an aeronautical engineer to design a helicopter which will be capable of raising itself and its pilot from the ground and maintaining its position in the air. Unfortunately, however, the problem does not rest there, for if the machine is to be of practical use, the vertical motion must be transferable into a horizontal movement over the ground, and, further, it must have some measure of stability, be controllable while flying, and be such that its rate of descent is controllable under all conditions, with and without the engine. The generally accepted method of obtaining forward movement is to rotate the screws about their axis, so that they can drive the machine horizontally when it is partially supported by small aeroplane surfaces; or, where these are not provided, to set the screws at such an angle that their upward lift is still sufficient to maintain height while giving the machine translational motion. The latter method would appear to be one of obvious inefficiency, while in both cases the weight of the necessary gearing renders it difficult to imagine, in the writer's opinion, that the helicopter can equal the efficiency of the aeroplane on the basis of load carried per horse-power.

There are two distinct types of helicopter of the modern school: one having two screws mounted one above the other on the same axis, and the other having two or more screws each carried on a separate axis. The first has the obvious advantages of greater mechanical simplicity, for it involves possibly but one set of gears, and so saves weight; whilst the arrangement embodying separate axes will undoubtedly ensure greater efficiency of the screws, as there will be no interference between the two slipstreams. In both

cases the screws are usually made to revolve in opposite directions, for otherwise the whole machine would simply be turned on its axis when the engine is started.

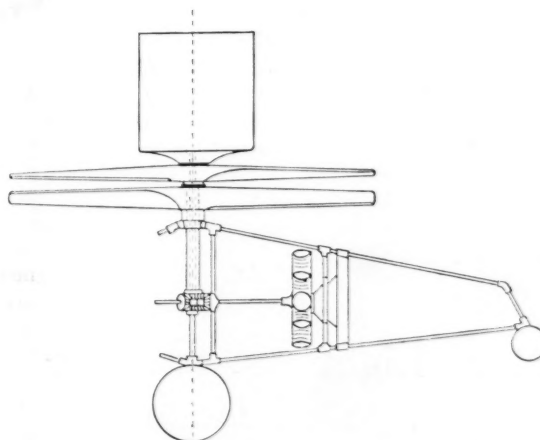
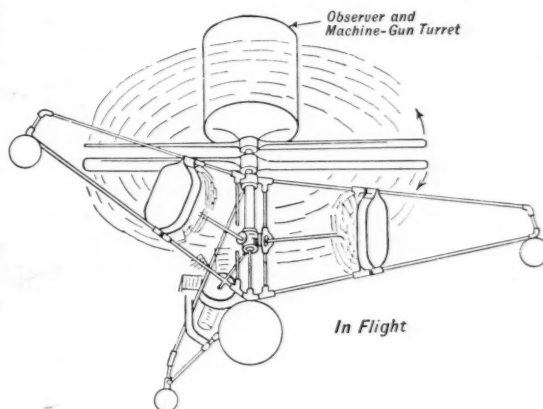
To the first class belongs the helicopter designed by a Spaniard named Pateras Pescara, with which trials have taken place at the Four Winds Aerodrome near Madrid, in the presence of officers appointed by the Aeronautical Department of the French Government. The machine, which has actually left the ground, though details of the flight are lacking, consists of what is to outward appearance a motor-car from which rises a vertical shaft. On the shaft are the two lifting screws, each of which consists of four arms in the form of small biplane surfaces. The chief feature of this machine is that each arm of the screws appears to be of ordinary aeroplane wing form, which one would not have thought likely to be efficient when following a rotary path through the air. Details of the span and engine power of this machine are unfortunately lacking, as are particulars of the mechanical design, although it is understood that the lifting screws can be swivelled for horizontal motion.

A promising American helicopter is the Crocher-Hewitt, the screws of which are 51 feet in diameter. Each screw consists of two tubular steel arms, at the extremities of which are the four blades made up of ribs riveted across the steel tube and covered with aluminium sheeting. Horizontal motion in this design is obtained partly by tilting the screws and partly by altering the position of small auxiliary surfaces, and utilising the down draught from the screws on these surfaces to drive the machine in the required direction. Two 100 h.p. motors are fitted.

Lieutenant Petroczy and Professor Karmen have produced in Austria a helicopter which is not designed for horizontal motion, but is intended to replace an observation balloon, as it is less vulnerable to attack from hostile aeroplanes and a smaller target for artillery. It is flown on a wire from the ground, and the observers sit in an armoured turret above the screws. The main framework consists of three horizontal frames, on which are carried the three 120 h.p. Le Rhone engines, which provide the motive power. Shafts from the three engines drive through bevel gearing two vertical shafts, one revolving inside the other, on which are carried the wooden two-bladed screws, each of which is 20 feet in diameter. This machine has made numerous ascents, and is said to have reached a height of 300 feet or more.

Of helicopters with the lifting screws working on separate axes, perhaps the best known is that of M. Damblanc, who read a paper on the theory of his machine before the Royal Aeronautical Society in 1920.¹ This machine has an ordinary aeroplane

fuselage, with rudder and elevators, while in place of the wings are two four-bladed lifting screws of special design, somewhat reminiscent in shape of a clover-leaf. These screws, which are rotatable in order to obtain horizontal motion, are driven from two separate Le Rhone 120 h.p. engines. For safety of descent in case of engine failure, the angle at which the blades meet the air can be varied at the will of the pilot.



DIAGRAMMATIC SKETCHES OF THE KARMEN-PETROCZY HELICOPTER.

Another American helicopter, belonging to a different school from the Crocher-Hewitt, is the Leinwerer-Curtiss, which again has an aeroplane fuselage with a rudder, but no elevator. The means of sustentation selected here consists of four three-bladed propellers, arranged on a somewhat novel plan. They are placed in pairs on each side of the fuselage, each pair being mounted at opposite ends of a massive arm containing at its centre the gearing from which the drive is received from the engine in the fuselage. The arms

¹ *Aeronautical Journal*, vol. xxv, No. 121.

can be rotated about this point when it is desired to make the propeller axis horizontal.

In conclusion, the Oechmichen, another French helicopter, may be mentioned. The chief feature of this machine is the special form of screws used, which are two-bladed, each blade being shaped after the manner of a bird's wing. M. Oechmichen claims to have discovered a secret of bird flight in that certain birds or insects are capable of utilising in flight the suction caused by the passage of their wings through the air to give additional support, and it is to test his theory that these screws are designed. A screw of this kind is carried at each end of a light framework of box-girder design, the drive from the Dutheil Chalmers engine (of the remarkably low power of 25 h.p.) being by belting. In trials that have so far taken place, a small balloon was fitted above the machine, but the fact that this was merely to relieve the inventor, in the early stages of experiment, from having to worry over problems of stability, is evidenced by the fact that the helicopter rose from the ground with a total weight of 700 lb., although the lifting force exerted by the balloon was only 150 lb.

The multiplicity of ideas and the wide variation of design might lead one to suppose that the helicopter is merely a "freak," were it not for the fact that quite as much doubt regarding the correct line to adopt in aeroplane experimentation existed so recently as ten or eleven years ago. It would not be wise, therefore, to be misled by present-day conflicting notions, but to watch the trend of design as order arrives out of chaos. The solution of the problem will come, the present writer is inclined to believe, not through the sudden appearance of an epoch-making discovery, but from the steady development of known mechanical principles.

New Light on the Silver Age of Hellas

By J. U. Powell, M.A.

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THE Mediterranean lands are slowly giving up their secrets. Several articles have appeared in DISCOVERY dealing with the new light cast upon early civilisation in the Eastern Mediterranean by the discoveries in Crete and on the mainland. These discoveries reveal a civilisation which preceded the Greek age; and, although we cannot yet read the written records, we can largely reconstruct the history from the remains of the civilisation themselves. This paper deals with a later age, with fresh evidence upon the close of the

classical Greek period, when its brilliance, though not its influence, had begun to wane. It is the period between the Athenian and the Roman age in the Eastern lands, roughly speaking from 350 to 150 B.C.

In the fifth century B.C. the great Athenian statesman Pericles is said to have proudly boasted that Athens was "a liberal education to Greece." But in these centuries we see, not Athens, but Greece becoming a liberal education to the nearer East through the conquests of Alexander, and to the rising and conquering power of Rome through the numerous centres of Greek culture spread over the shores of the Mediterranean.

The Greek literature which we possess is but a fragment—a large fragment, no doubt—of all that was written. But more is coming to light. Some of those authors who were little more than names, and whose works are only known to us by the briefest mention, are becoming personalities to us through recent discoveries, disinterred mainly from the sands of Egypt and the lava of Herculaneum.¹ They are not by any means all Athenian. The brilliance of Athenian genius in the fifth and fourth centuries B.C. has largely eclipsed that of the writers in other parts of the Greek world; but when Athens came to be only the most distinguished of many cultured cities after the middle of the fourth century, we can see more clearly how widely diffused and how prolific Greek culture was. After the death of Alexander the Great in 323 B.C. the kingdoms of the Eastern Mediterranean were thrown into the melting-pot. But meanwhile, in the central Mediterranean, another power, that of Rome, was rising and spreading its influence, and its great Empire was taking shape; a political success in its own strength, but intellectually inspired and infused by Greek thought. It was in these less brilliant centuries that those writers flourished who influenced Roman thought directly in the departments of philosophy and poetry, and it is the life of these important centuries that is now being continually brought to light from Papyri and inscriptions.

Let us take first that side of Greek life which has largely occupied the attention of scholars during recent years, and which may almost be called a new department of study—Greek Religion; and first the cult of Apollo. His oracle at Delphi was one of the most famous institutions of antiquity; and though the cult gradually decayed and finally vanished, a certain splendour surrounds it even in its later years. Two out of the five Hymns inscribed on stone and discovered at Delphi in the closing years of the last and the opening of the present century are remarkable, one for a vocal, the other for an instrumental, score which

¹ This was a Greek settlement on the shores of the Gulf of Naples overwhelmed by the great eruption of Mount Vesuvius in A.D. 79, and first rediscovered in the year 1738.

accompany the words. When we see the magnificent remains of Greek temples, as, for instance, at Athens or Paestum,¹ it is not difficult for the imagination to reconstruct the appearance which they presented when thronged by worshippers at some festival. Such a scene is presented by the words of these hymns, which speak of the processions, the choir singing and dancing, their long hair flowing down, the flutes playing, and the sweet incense rising into the air, as they celebrated the miraculous deliverance of the Delphic temple (in 278 B.C.) from the invading Gauls. The ritual had become a fine art, for we hear of guilds of professional performers at Athens. Strongly contrasted with such stately ceremonial is a primitive piece of magic ritual, appearing in a hymn found in Crete, in which the worshippers "leaped" to secure fertility for their flocks and fields, singing a kind of Rogationtide Litany. But there is little permanence for a religion consisting only of miracle and ritual, and less for one of magic, and these types were doomed to pass away. The higher aspirations of the period will come before us presently in a different form; meanwhile let us look at some pictures of ordinary life at three typical centres—Athens, Cos, and Alexandria.

Comedy is a good mirror in which to see contemporary life. The earlier comedies produced in the days of the Athenian Empire and the Peloponnesian War were largely political pamphlets. But by this time the keen political interest of Athens had passed away. The chief writers of the later or "New" Athenian Comedy, Philemon and Menander, present us merely with pictures of everyday life, a comedy not of politics, in earnest or burlesque, but wholly of manners; they hold up the mirror to social and private life, and so far they were among the teachers of their times.

In their dramatic writings we are introduced to a comfortable middle-class society, in which the father often goes a long voyage on business and comes back to find, like Odysseus, trouble at home. The son has been sowing his wild oats, dicing, drinking, falling in love, and then thinking of enlisting for Caria or far-off Bactria in some Foreign Legion; hence arise complications and difficulties, closed by a reconciliation; in short, the kind of incidents which meet us in the late Victorian novel.

Menander intended the spectator to profit by what he saw. Here is a characteristic passage from his play *The Guardians*:

"Smicrines. By the gods——

Onesimus. Gods? Do you suppose that the gods have leisure enough to assign good and evil day by day to each man separately?

¹ This was originally a Greek colony, set on the shores of the Gulf of Salerno, about fifty miles south of Naples.

S. What do you mean?

O. I will make it clear to you. Speaking roughly, there are a thousand cities in the world, each with thirty thousand inhabitants. Do the gods ruin or save each individual?

S. How could they? A laborious kind of life they would have!

O. 'Do they, then, take no heed of us?' you will say. Well, in each one of us they have implanted his character as the commandant of his soul. This inward power is one man's ruin, if he make a bad use of it, but saves another. This is our Daimon, the cause of each man's prosperity or failure. Make this Power propitious to you by doing nothing absurd or foolish, so that you may prosper."

Menander shows a genial good sense, which reminds one of Horace, and, like Horace, he is a mine of pithy sayings.

A story of real Athenian life about this time is brought before us in one of the newly-discovered speeches of Hypereides, a clever lawyer and orator of the fourth century B.C., in which a young booby of a country gentleman falls into the clutches of a fraudulent vendor and a courtesan. The story is this. The young man wanted to buy the freedom of a slave-lad who belonged to an Egyptian engaged in a perfumery business at Athens, but was told that this could not be done, unless the freedom of his father and his brother was also bought. The woman, in whose clutches he had already been, persuaded him to buy the three outright for about £120. A draft agreement was produced with suspicious promptness, and the vendor read out the terms, the buyer of course being in a hurry; soon after it had been sealed, the buyer discovered that he had bought not only the slaves, but also their debts, which the woman had represented to be small. But creditors sprang up on all sides, and the total amounted to no less than £1,200. One of the slaves had been the vendor's manager in the perfumery business, and these debts had of course been incurred by the vendor through his manager! No wonder that "to play the Egyptian" was an Athenian colloquialism for "to be a rascal"!

Pictures of vulgar life come before us in the island of Cos in the south of the Ægean. It was a busy and well-governed place, perhaps with a daily service of vessels between it and the great city of Alexandria; a literary centre, and possessing the tradition of a celebrated school of medicine. But it had a seamy side. The new author Herondas gives us scenes from everyday life, some rather sordid, in poems containing dialogues generally between women. In fact, women form the subject of all of them. They gossip about the "eternal servant question"; they attend worship

at the temple of Asclepius; and in one poem, the scene of which is probably laid at Ephesus, they spend time pricing expensive shoes in the shop of a glib and plausible shoemaker. Here is an extract:

"*Shoemaker.* Boy, open the box and bring out some of my best works of art. Look quietly in, madam, and open the shoe-case. Look at the heel, and the ornamented pattern on it! All good workmanship! And the grain! Incomparable! Look at the latest fashions! Here are your parrot-coloured shoes, your crab-coloured shoes, your scarlet shoes, your orange-tawny shoes; ankle-tips, night-trippers, laced boots,



THE BUST OF MENANDER IN BOSTON MUSEUM (U.S.A.).
(Reproduced, by kind permission of Wm. Heinemann, from "Greek and Roman Portraits," by Anton Hekler.)

loose boots, slippers, sandals. Say what your heart desires.

Lady. How much do you want for the pair you took up first? Don't name too 'thundering' a price.

Shoemaker (after some voluble protestations). Three pounds ten, madam, not a farthing less."

It is a high price, even for the extravagant lady; but after haggling, she buys some shoes, and the woman who introduced the customers is promised a pair as commission for herself. A vase-painting has been preserved of such a scene, a lady visiting a shoemaker and being measured. But in two of the pieces

the figures are of a coarser and lower type, and in one of them the moral corruption inherent in ancient slavery appears very plainly. Among male characters we read of pugilists, garotters, gamblers, or seafaring men ashore for a carouse. The streets of the town are narrow, with mud up to the knees, like a Turkish town of the present day. The language put into the mouth of these people is that of common life, colloquial, full of vulgarisms, slang, and proverbs. The author is a "Realist" to the core, and has been well called the Teniers of Greek literature. His most entertaining piece is entitled *The Schoolmaster*; the characters in it are a truant boy, his angry mother, and a schoolmaster, on whom she is paying a parental visit. Her complaint is that her boy will not attend school, but prefers disreputable company, such as porters and runaway slaves, with whom he plays pitch-and-toss. Even when his father helps him to write from dictation, he will have none of it; and if he is scolded, he runs away to his grandmother's, or climbs up on to the roof and sits there like a monkey, and breaks the tiles, for which his parents have to pay. In short, he is an imp of mischief, and the neighbours put everything down to him. The schoolmaster promises to cure him, and in spite of his roars for mercy gives him a sound flogging; and even so, says his mother, the flogging has not been enough: "Whip him till sunset."

Let us now turn to Alexandria. Here, too, the Papyri give us glimpses of low life. The great port was the meeting-place of travellers from the Eastern and Western seas, and there were the amusements which we should expect in such a place. Scraps have been preserved apparently from farces performed in music-halls. One, for instance, perhaps from the first century B.C., introduces a tipsy sea-captain with his boon companions male and female. Another is part of a farce in which the scene was perhaps laid on the coast of Southern India, if the identification of the language in which one of the characters speaks is correct, for it is thought to be Kanarese. It is a story of adventure; a Greek maiden, held captive by Indian barbarians, is rescued by her brother, who makes the Indians and their king too drunk to pursue them. Not only were Greeks great travellers, but India had intercourse with Egypt. We know from the inscriptions of the great Buddhist, King Asoka, that there were Buddhist missionaries in Egypt in this period. Other fragments are of a lower nature and more sensational.

But we must not think that the morals of that generation in Egypt were as miry as the streets of Cos, or that its mind was as narrow and tortuous. More respectable people appear in the private correspondence of the Ptolemaic era (323-31 B.C.) which has come to light and which reveals a well-governed,

prosperous and industrious society of business men, farming on scientific principles, learning mensuration, draining and irrigating their arable land and vineyards, and paying rent and taxes. And in 245 B.C. we read of a strike of slaves who worked in a stone-quarry, and deserted. Nor were the amenities of social life wanting, as may be seen from the following letter of about the same year:

"Demophon to Ptolemaeus greeting. Do your best to send me Petoüs the flute-player with the Phrygian flutes and the others; pay any necessary expenses, and I will refund them. Send me also Zenobius with kettle-drum, cymbals, and castanets, for the ladies require him for the sacrifice. Let him also be dressed in the finest clothes. Get the kid also from Aristion and send it to me; and send as many cheeses as you can, and a new jar; and vegetables of all kinds, and any delicacies which you have. Good-bye. Put them on board with the guards who will help to bring the boat."

One point of some historical interest appears. It is probable that in a letter of A.D. 41 we have the earliest known reference to the Jews as money-lenders. A person involved in some money difficulties in Egypt is written to as follows: "Say to him [i.e. to the creditor], I am not like anyone else, I am a lad. . . . We have many creditors; do not drive us out. Ask him daily: perhaps he can take pity upon you: if not, do you, like all people, beware of the Jews."

Turn now to the more serious side of this newly-found literature which meets us in the Philosophers and Moralists. The different schools of philosophy all had their popular teaching and they were the guides of life for the educated class. As we have already noted, works by Philodemus and Polystratus have been deciphered from the charred rolls of Herculaneum. They are popular expositions of Epicureanism; and there is also a similar exposition of Stoicism of a rather later date, the first century A.D., by one Hierocles. Polystratus, a new writer, with his earnest and intense convictions, reminds us constantly of the great Roman Epicurean Lucretius. "Only by the knowledge of the *Phusis*¹ of things," he cries, "can men be freed from their enslavement to False Notions and Perturbations, from all Commotions and Fears. This alone makes life free." But how serious these teachers were can best be seen from the remains of another Epicurean who lived in the second century A.D. In a small town called Oenoanda, some thirty miles inland from the Asiatic coast opposite Rhodes, a long and remarkable inscription was discovered a short time ago on a ruined stone portico. The philosopher's name was Diogenes, and the inscription which he

wrote opens thus: "I have observed that mankind was worried and troubled and distracted with unnecessary matters; and I felt pity for their life and wept over the perdition of the times, and have decided that it is a good man's duty to come to their help." . . . With apostolic earnestness, and actually in apostolic language, he goes on: "Now that I am an old man and the sun of life is sinking, and I shall soon depart from life, I would do what in me lies. . . . Most men catch the infection of False Notions, one from another, like sheep. . . . I have resolved to make use of this portico to publish the Medicines of Salvation. It is right also to help those who will come after us, since they too are ours, even though they have not yet been born; and to help strangers too, for that is humane" ("philanthropic" is his word).

Place beside these a writer of quite a different tone, Cercidas, who lived in the third century B.C. and belonged to the school of philosophers called Cynics (lit. "doggyish"), from their contempt for elegance and even for decent conventionalities. He may be regarded as practically a new author. He writes a lyric metre in a concise and mordant style, coining words with such facility and vigour that they produce a most emphatic effect. He inveighs against the unequal distribution of wealth, fiercely denounces luxury and high living, the "swinish wealth," enjoyed by "sepulchres of fat," as he calls the profiteers of those days, in two of his vigorous new words. "Why should spendthrifts and misers have the money, and not I?" he cries—and we fancy that many of our modern authors will heartily agree with him! "Is Justice as blind as a mole, and has the brightness of Themis been dimmed? How, then, do the gods come in, who have apparently neither the power of hearing nor of seeing?" He leaves the answer sarcastically to the "sky-praters," who he expects will not find the least difficulty. "But let help for the sick and charity to the poor be our care."

The idea of the community of property had been in the air during the fourth century. It had been ridiculed by the radiant wit of Aristophanes in the *Women in Parliament* and the *Plutus*; it had occupied the mind of Plato in the *Republic*, and met with the grave criticism of Aristotle in the *Politics*. But in the third century it had become a burning question in the south of Greece because of the military needs of Sparta. The most recent writer upon Cercidas suggests that his attack upon the grasping and vicious rich was meant as a warning to his own party (in his own city of Megalopolis, a near neighbour of Sparta) to mend their ways before it was too late, for the time might come when the rich would have to "disgorge."

The same theme is treated in a fragment of a new poem by Phoenix of Colophon, who lived about a

¹ The word means "the Law or process of Growth." The usual, but rather misleading, rendering is "Nature."

generation before Cercidas. He directs vigorous satire against the rich with their splendid houses and their immense property, while "their real selves are worth —three-halfpence." Two other poems attack the vice of greed: "Everyone is the moneyed man's friend: if you are a rich man, even the gods will love you; but if you are poor, your own mother will hate you."

Here we have, even in this later age, the old virility of Greek thought and its determination to cut to the root of the matter. And our own generation may well take to heart this splendid tradition of the Greeks, their eager quest for knowledge, their burning zeal for truth, their call to never-ceasing moral effort, in which they found their "Medicines of Salvation."

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The Problem of Graft-Hybrids

By F. E. Weiss, D.Sc., F.R.S.

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GRAFTING, i.e. the insertion of a small shoot or scion of one plant into a cut stem or branch of another living plant with a view to their uniting, seems to have been practised from time immemorial. It is said to have been carried out by that wonderful and inventive people, the ancient Phœnicians, and we have many records from Roman times of its practice. Vines were certainly grafted in those days, though for what purpose we know not, and it was evidently thought that plants quite unrelated to one another might be joined by grafting, for according to Vergil (*Georgics*, lib. ii)—

"Vigorous apples are grown on the barren plane,
 A beech bears chestnuts, a mountain-ash the silver shine
 Of pear-blossom; under an elm have acorns been crushed
 by swine."¹

We have, however, no experimental evidence that plants differing so widely from one another as those

mentioned in the above passage can be successfully grafted one upon the other. Some degree of relationship, such as is indicated by their belonging to the same Family or Natural Order, seems to be necessary to enable the tissues of the two plants to unite. Thus a pear can be grafted upon an apple or on a quince, but not upon an ash.

Whether in the case of a graft the stock produces any change in the inserted scion or not has been a subject of great controversy. If any such influence were exerted by the stock, a good deal of the value of the process as practised at the present day would be lost, for valuable or choice forms are frequently grafted on wild stock. So far only one form of transmission of characters from stock to scion and vice versa has been scientifically established, and that is in the case of variegated plants. Shoots of plants with variegated foliage are often grafted upon common green stock, and the latter seems to become infected by some virus from the variegated scion so that all the leaves it forms later on will partake of the parti-coloured nature of the stock. Most of the other cases of apparent transmission of characters from stock to scion seem capable of explanation by the undoubted interference with the smooth passage of food-material across the line of union of the two plants.

There are, however, a few cases known of grafting having been followed by the production of shoots exhibiting characters intermediate between those of the stock and the scion. In these cases the graft has generally not succeeded, and after the inserted shoot or scion has died down to the base, a bud has been formed near the juncture of the two plants, and the shoot, which has arisen by growing out of the bud, has presented such a blending of the characters of scion and stock that it has been called a graft-hybrid, and has been taken to have resulted from a complete union of vegetative tissues similar to that of reproductive cells. This in the case of such different plants as we have in stock and scion might produce a seed-hybrid.

The first graft-hybrid recorded in scientific literature is the case of the famous Bizzaria Orange grafted in 1644 in Florence on a Lemon stock. This remarkable tree bore at the same time oranges and lemons and other fruits which partook of the nature of both kinds, either blended together or segregated in various ways, some, indeed, having an orange shell but a lemon pulp.

A better known instance of a graft-hybrid is that of the so-called Purple Laburnum (*Cytisus Adami*), which is very fully discussed by Darwin in *Animals and Plants under Domestication*. This interesting plant, specimens of which are now found in most botanical and in many private gardens, originated in Paris in 1825 from an attempt to engraft the small Purple Broom on the stem of the ordinary Yellow Laburnum. In

¹ Dr. A. S. Way's version.

this case too, as in the Bizzaria Orange, the graft did not succeed, but later a branch grew out from near the insertion of the graft, which in its foliage and flowers was intermediate between the stock and the graft. By many it was considered that it might perhaps have been a seed-hybrid which the nurseryman had endeavoured to graft upon the Laburnum, but no such hybrid is known, nor has it been possible to obtain this seed-hybrid of these two plants by the ordinary methods of crossing. Moreover, *Cytisus Adami* exhibits what is one of the most striking phenomena of graft-hybrids, namely the tendency to revert back to the constituent plants, which may be regarded as its parents. Thus three different types of foliage and flowers may after a time be observed on most of the specimens of *Cytisus Adami*. The flowers are represented by long grape-like inflorescences with flowers of yellow colour, shorter clusters of somewhat purplish flowers, while on the branches exhibiting the foliage of the Purple Broom small purple flowers are born in pairs. Such a segregation of characters on one plant is very rare in the case of seed-hybrids, but characteristic of graft-hybrids. A detailed microscopic investigation of the plant by J. M. Macfarlane also revealed the fact that the hybrid portion seemed to be "wrapped round, so to speak, by a skin" of the Purple Broom, which feature we may fittingly compare with the "orange shell and lemon pulp" of some of the fruits of the Bizzaria Orange mentioned above. Indeed, this peculiar form of segregation of characters in definite layers, as well as the tendency to reversion, seem to be characteristic of many graft-hybrids.

Early in the present century Dr. Hans Winkler set out definitely to produce other graft-hybrids, selecting for his experiments the genus *Solanum*, which seemed to him for certain reasons a very suitable subject. Grafting young shoots of the Tomato on the stem of the Nightshade and vice versa, he found that he readily got these two related species to unite. He then cut transversely through the region of the graft, thus exposing the living tissues of both plants. The wound so inflicted was rapidly covered by a healing tissue known as *callus*, upon which numerous new buds were formed. Some of these grew out into branches of Tomato or of Nightshade according to their point of origin, while in some cases where the two tissues were close together, a branch might be formed half of which was Tomato while the other half bore leaves and flowers of the Nightshade. Such growths he called *Chimæras*, after the fabulous monster of antiquity, part lion and part dragon. Very occasionally, however, shoots were produced in which the characters of the two constituent plants were blended, and these he regarded as graft-hybrids. They also showed a tendency to revert to their constituent parents, and an

important feature was the fact that, though the shape of their leaves was intermediate, their outer covering was purely that of the Tomato or of the Nightshade according as to whether the latter or the former was



FLOWERING BRANCHES OF THE GRAFT-HYBRID (*CYTISUS ADAMI*) AND OF ITS PARENTS.

A. The Purple Broom (*Cytisus purpureus*) with small leaves and short purple flowers. B. The common Yellow Laburnum. C. The graft-hybrid, with leaves of intermediate size, and flowers in which the outer layer of the petals is purple, while the inner tissues are yellow. This gives the flower an intermediate colour.

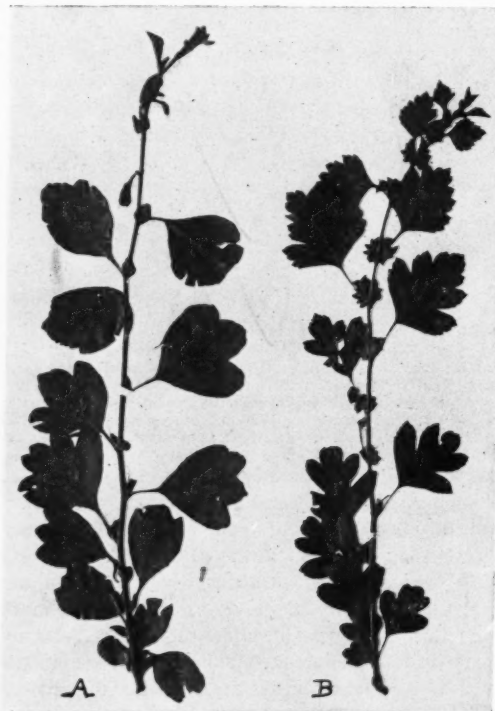
the stock. It was, therefore, argued that in these experimental hybrids there had been no true vegetative fusion of cells comparable to the fertilisation of a seed, but that they represented the core of one plant surrounded by the skin of the other, very much as a finger may be covered by a glove. Further examination proved this to be correct. The internal cells partook of the nature of the stock, while the skin, or epidermis, was that of the inserted graft. Buds of this kind might readily arise from the wound tissue in which the cells of the two plants must be variously arranged, and in the production of a bud the inner cells of the stock might easily be covered by a cap of cells belonging to the scion. It has been suggested that, as these two types of cells largely preserve their own characteristics, these so-called graft-hybrids are really more of the nature of the chimæra mentioned above, but that, instead of the tissues of the two plants being side by

side, they are arranged one around the other. Such shoots may, therefore, be termed *Periclinal Chimæras*. A re-investigation of *Cytisus Adami* in the light of this new theory has shown that it, too, as adumbrated by Macfarlane in 1892, is of the nature of a periclinal chimæra, with the core of the Yellow Laburnum and the skin of the Purple Broom. Its tendency to revert to its two constituent components can, therefore, be more readily explained, and indeed it is possible to stimulate it to revert to the ordinary Laburnum by pricking its buds, thus injuring the skin, when the core pushes its way through to heal the wound, and thus the shoot becomes covered by a tissue similar to that constituting its core.

One feature interesting to note in this connection is that, though *Cytisus Adami* rarely fruits, its seeds when fertile always give rise, as far as is known, to the ordinary Laburnum. This can now be explained by the fact that the reproductive cells are formed from

On the Continent it is very common to graft the Medlar on a Hawthorn stock, and in two instances graft-hybrids have been produced from plants grafted in this way. Their rare occurrence is, of course, due to the fact that in most cases such grafting is successful, and it is only when the graft fails or subsequently dies that there is a chance of a bud being produced which contains the tissues of both plants. *Cratægo-mespilus*, as the graft-hybrid has been called, is known in two forms, both of them intermediate between the Hawthorn and the Medlar, but one resembling the former more closely, while the other is more like the latter. In this case it is suggested that the form more like the Hawthorn represents a periclinal chimæra with one layer of Medlar cells clothing the Hawthorn core, while in the other form the covering of Medlar cells is more considerable. This explanation seems to fit some of the features exhibited by this interesting plant. Thus, for example, this hybrid's fruits, which in one of the forms resemble in shape and size those of the Hawthorn, are not red like our haws but brown like the Medlar, being clothed with a dark layer of cork characteristic of that fruit. Also the seeds of this form, when fertile, produce pure Hawthorns as one would expect in a periclinal chimæra. There are, however, some phenomena which cannot be so easily explained by the chimæra-hypothesis, and the subject is still under investigation.

Another graft-hybrid has recently been recorded by Professor Daniel, one of the foremost French authorities on grafting. In Brittany it is customary to graft certain forms of pears on a quince stock which has less vigorous roots than the pear, and thus keeps the trees in a more dwarf or pyramid condition and also promotes earlier and better fruiting. By cutting down to the point of union old plants which had so been grafted, Professor Daniel caused them to produce new shoots near the juncture of stock and scion, and some of these proved intermediate between the two. Though they have been produced some little time ago, they have so far not flowered—a fact which may be taken to suggest that they are true hybrids, or at any rate different from the so-called hybrids mentioned above, which flower freely. An examination of the leaves and stems seems to indicate that they are not periclinal chimæras, and it may well be that we have in this case a more intimate union of the vegetative tissues than in the examples cited above. We may, therefore, take it that, though the chimæra-hypothesis of graft-hybrids has cleared up some of the difficulties which have beset the investigators of these curious productions of horticultural practice and experimental skill, the last word on this subject has not yet been said, and that further work on this interesting problem in plant genetics is likely to be fruitful of important discoveries.



A. A BRANCH OF ONE OF THE GRAFT-HYBRIDS OF THE MEDLAR AND THE HAWTHORN.

The leaves are less deeply lobed than in the Hawthorn, and are hairy like those of the Medlar.

B. A BRANCH OF THE COMMON HAWTHORN, FOR COMPARISON.

the inner tissues of the plant, and so are entirely those of the Laburnum. Similarly, in Winkler's so-called graft-hybrids the seeds never gave rise to hybrid plants, but only to the plant which formed the core of the chimæra.

Irrational Fears

By F. A. Hampton, M.C., M.B.

FEAR, with its accompanying instincts of flight and concealment, is primarily a self-protective measure called out by the presence, or even more strongly by the approach, of danger. The attendant physical reactions, the quickened heart-beat, the deepened respirations, the sweating, and the increased tension of the muscles are preparations for the activity of flight, and, if our hair does not commonly stand on end, there are many who have experienced during the late war a certain uncomfortable feeling of tightness in the scalp which is equivalent to the raised hackles with which the cat or dog seeks to magnify his stature and inspire his enemy with the terror that he is probably feeling himself. Besides the impulse to flight, there is also a passive aspect to fear in which the individual becomes paralysed with terror; and this seems to be the last extremity of fear, evoked usually in the face of overwhelming danger and corresponding to the reaction of shamming dead which is found in many of the lower animals.

The mental state, disagreeable though it be, also contributes to the scheme of protection, for it is one of intense awareness and alertness, an attitude expressed, it may be noted, by the roots of the word "apprehensive." As George Borrow said, "the eyes of fear are marvellously keen."

Both the mental and physical phenomena of fear may therefore be looked upon as reactions on the part of the organism to cope with a danger threatening it from without, but there are fears in which these reactions seem to have little or no protective value, for the exciting cause either contains no element of danger, or so little that the emotion evoked is altogether disproportionate, and we are tempted to call these fears baseless or irrational. But if we examine them carefully, we find that, however bizarre they may seem, they are nevertheless the result of a connected and logical train of thought; the logic, it is true, may be childish logic, and such as the conscious mind would reject if it were able to criticise it, but the sufferer is unaware of the lines along which the fear is formulated and only receives the end-result of the process, so that the dread appears as an isolated phenomenon, inexplicable and mysterious.

Such fears are common enough to have been felt at some time by most people, and they do not, of course, connote any essential timidity of character, for there are few who cannot discover in themselves some private and particular fear, though out of self-regard it is often minimised as a mere aversion or antipathy. Many such fears stand out by their seeming incongruity

with the rest of the character, and when they occur in great men we note and seem to prize them as a spot of weakness that marks the kinship of the hero with our common humanity. Grettir, the Saga hero, was afraid of the dark, Nelson was afraid of horses, and Napoleon of a cat.

While these fears are trivial enough in their effect to pass for mere eccentricities, yet they grade imperceptibly into neurotic conditions where life is made unbearable by fears that the victim realises to be irrational but cannot overcome by any exercise of will or reason. It is more especially to these fears, and for their relief, that the modern advances in psychology have been applied, but the discoveries made in this sphere illuminate equally those smaller fears of everyday life that we have hitherto accepted as capricious and inexplicable. These fears may be arranged, for purpose of description, in three groups: (1) Those of which the exciting cause seems to lie in some forgotten fright or shock, usually occurring in childhood; (2) those cases in which detailed investigation discovers the presence of a hidden fear, whose existence the individual is unwilling to admit to himself and of which he contrives, by a purely unconscious and apparently effortless process, to remain unaware; (3) those cases in which the fear is found to serve as the protection against the fulfilment of a hidden wish or desire.

As an example in the first group we may take the case of a person who was acutely afraid of stagnant water, but not (though he was unable to swim) of rivers or the sea; this fear was found to date from a narrow escape from drowning in a stagnant pool when he was about four years old, an incident that he had completely forgotten and only recalled to memory after long trial. The fear persisted because he still continued to react to the pond or canal as a child of four, and it was only when the memory and association were restored that he was able to apply the criterion of adult experience and banish the fear.

In the second group the individual is afraid of something that he will not, or dare not, admit to being frightened of, but the *feeling* of fear cannot be altogether extinguished, and tends to find expression by some channel to which the conscience or *amour propre* can take no exception. The feeling, which is thus displaced from its true object, may—

- (a) Reactivate a childish fear; or
- (b) Become attached to some object that can stand as a symbol of the true fear; or
- (c) It may intensify one of the common, instinctive fears of mankind.

(a) Many fears, that persist from childhood and are confidently attributed to some early shock, prove on close examination to owe their survival to reinforce-

ment from some secondary source of fear, and in cases where the original shock still remains vivid in the memory, the presence of some accessory factor is always to be suspected.

(b) The transference of a fear to its symbolic equivalent may be illustrated by the case of a man who was in greater danger than he supposed of yielding to a passionate attachment that threatened to wreck his family life; he professed to feel master of himself and quite secure, but he developed an exaggerated fear of the house catching fire, and was unable to sleep from anxiety lest "something might be smouldering somewhere."

The fire was here accepted as a symbol or equivalent of passion, a simile stereotyped by common use, and though such a literal substitution may appear unreasonable, yet it is a process not altogether alien to our common mode of thought, for we see nothing bizarre in, let us say, the action of the German people in tearing down the Imperial monogram after the revolution.

(c) The common fears of mankind are those instinctive fears that appear, many of them, irrational in the setting of our civilisation, but which one may speculate to have been serviceable to our primitive ancestors. They include the fear of the dark, of open spaces (*agorophobia*), of being shut in (*claustrophobia*), of being alone, of heights, of the unfamiliar; fears that we have all felt at some time, howsoever faintly. They represent a specialised and inherited sensitiveness to particular modes of stimulation, and they are easily reactivated by any free or diffused fear that is seeking a means of expression.

The nature of the particular fear is determined most often by its congruity with the true object of fear; thus a boy, who has broken away from the home circle and set up for himself, may regret the security that he has left, and find, though too proud to admit it, something a little terrifying in his new liberty, and then perhaps he develops a strange fear of empty streets and wide open spaces, that symbolise for him his unprotectedness and isolation.

It is not without interest to endeavour to trace the origin of some of these common fears that seem to have outlived their usefulness; the fear of darkness has still a protective value amongst those primitive tribes who are liable to night raids from hostile neighbours, and who compete on more or less equal terms with the nocturnal carnivora; for the man who wandered care-free in the dark was a type likely to be eliminated by natural selection.

So the old mode of reaction lingers on, and we do no great violence to the theories of heredity if we see in the monsters with which a child peoples the darkness an unconscious recollection of the ancestral enemies.

The fear of open spaces is one to which few normal people would admit any liability, yet many of us, in crossing a wide, snow-covered field or a bare plain, may have caught in ourselves a tendency to glance backwards occasionally over our shoulder and felt a slight feeling of relief on reaching the "shelter" of the hedges and broken ground. And no one, in selecting a table in an empty or half-empty restaurant hesitates to prefer one against the wall to one in the centre of the room.

If we analyse a little this uneasiness called out by open spaces, it resolves itself into a feeling of being unprotected, especially from behind, and perhaps it is not altogether fanciful to see ourselves reacting here as primitive man, with his relatively inferior powers of flight, would and does react when caught at a disadvantage in the open. In this situation there is probably a secondary factor in operation, for man is a gregarious animal and liable to an acute feeling of uneasiness when separated from the protection of the herd.

In the choice of a "sheltered" position for meals we have, perhaps, a faint relic of that feeling of shame that many primitive tribes still attach to the act of eating, a feeling probably derived from the fact that the animal when preoccupied with the physiological functions, such as nutrition, excretion, and reproduction, is relatively defenceless, and for greater safety tends to carry them out in concealment.

The origin of the fear of heights as an instinctive fear seems almost to elude explanation, however speculative. Unlike the foregoing fears it is the reaction, though an excessive one, to a real danger, and it also differs from them in being almost absent in childhood, seeming to become more acute towards the end of life, so that the author of Ecclesiastes (xii. 5) gives it place among the disabilities of old age.

It has been referred, somewhat fancifully, to an instinct inherited from some arboreal ancestor, but there is no strong reason for believing that man's immediate progenitors were tree-climbing animals, or, if they were, for supposing them to have been liable to this particular fear. An origin has also been looked for in the fear of falling from the nurse's arms, a relatively tremendous height to a baby, and here the emotion might have a protective value if it were accompanied by a tendency to cling to the mother, a reaction that is rather less marked in babies than might have been expected.

The fear of height is, for the majority, excited most keenly on the top of a tower or the promontory of a cliff, and is often more intense when looking both down and outwards than when looking straight downwards. It is accompanied by an urgent desire to cling hold of something solid, which lends a little colour of proba-

bility to the theory of infantile origin. The feeling of fear is attached not only to the actual height, but also to the immensity and emptiness of surrounding space, which evokes more than a hint of that nightmarish terror of the infinite; yet for ninety-nine people out of a hundred there is no feeling of height in an aeroplane, unless it comes when flying alongside a bank of solid-seeming clouds, or when flying low near tall buildings, so that we seem unable to gauge, or even realise, the height unless there are intervening objects over which the eye can travel. This fear, which is one of the most intense, seems to affect adult civilised man more than children or primitive races, and to be absent in animals, so that we are tempted to associate it with a widely developed consciousness and to hazard that perhaps it reflects some deep inward sense of littleness and insecurity evoked by an image of the abyss and the concept of annihilation.

The dread of death is commonly held to be an instinctive fear, and Francis Bacon so classed it with no uncertainty when he said that "men fear death as children fear to go in the dark," but it is very doubtful whether normal man, fearful though he may be of injury and violence, is deeply afraid of death as such, seeming rather to go his way believing "all men mortal but himself," and where we find the fear of death a prominent trait in character we are inclined to suspect the presence of contributory, hidden fears; so that the dread of death should, strange as it may seem, properly find a place among the irrational fears, though, on account of its special relationships, there is not enough space to treat of it in this present category.

The origin of an irrational fear from a hidden wish or desire may be illustrated by the case of a clerk, underpaid perhaps, in a firm whose business methods are not over-scrupulous. He finds that he has opportunities of making money safely at their expense, but, being a strictly honest man, he neither yields to the temptation nor has he any conscious fear of doing so. Presently, however, he develops a fear that he may have borrowed stamps from the petty cash without repaying them, that he may have cheated the firm by using the office stationery for his private correspondence, and finally he develops an unreasonable nervousness of policemen. The fear thus becomes a most effective safeguard against yielding to the unconscious wish.

The classification of the processes by which an irrational fear may arise is necessarily artificial, for several may, and indeed usually do, contribute to a given case, as can be seen in the following example in which nearly all the processes dealt with coexist:

A young married woman developed rather suddenly an intolerable fear of being alone in a room; she could

give no reason for it, except that she had been slightly nervous in a similar way as a child, after she had been frightened by an old man peering through the window. She said that she had no cause to be afraid of anything. On examining the fear more closely, she could only add that she felt as though "something would happen" to her if she continued to stay in the room. On being asked to let her mind go free and try to imagine what might happen to her, she produced slowly and with long pauses the following picture: "I feel as though the floor might open up. And now I see a square opening lined with bricks; it is very deep and there is dark, muddy water at the bottom of it. (*Long pause.*) There is someone at the bottom who wants to pull me in. I can't see who it is. . . . Now I can see . . . it's M." M. was a man with whom she had been on affectionate terms before her marriage; he had lately reappeared in her life, but she "had tried to keep him out of her thoughts." She had been warned that she would "get into deep water," if she had anything to do with him. It took considerable time to analyse this vision, but eventually it was found that the brick lining and the water suggested a disused shaft of which she had been afraid as a child, for a small boy had been drowned in it, and his fate had been held up to her as a warning "because he ought not to have gone there, but he had been tempted by the chestnuts that were lying about." The fear of yielding to temptation (which implies a forbidden wish) and the resultant scandal and disaster were symbolised by falling or being dragged into the muddy well in which the little boy had been drowned—a little boy who, to her childish eyes, had been thus terribly punished for yielding to temptation. The localisation of the fear in the closed room was determined partly by the reactivation of a childish fear and partly by the feeling of being "hemmed in" that corresponded to the conditions of marriage hampering her freedom. She was afraid of being alone, because only if alone with the man would she be in danger of that intimacy that she both desired and feared. The symptomatic fear disappeared in this case, as it often does, so soon as its meaning was realised. But it is not to be assumed that all is well with the individual when this has been accomplished; he is the better off in being able to react directly and consciously to his difficulties, but his chief gain will probably lie in overcoming the tendency that led him to remain in ignorance of the true source of his fear.

For the irrational fear is in most cases the expression of an unsuccessful attempt to evade the real fear; the problem is relegated to depths below our conscious self and is there dealt with on lines that we can recognise as belonging to the mode of thought of the child or of primitive man—the type from which

our conscious mode of thought has evolved and with which it must, therefore, by the laws of development, retain a connection.

The conscious self can say, "It is *as though* I were standing alone and unprotected," or "It is *as though* I were getting into deep water," but to the primitive child-self the metaphor is real; to primitive man a "murderous look" is no figure of speech but actual fact, and the child soundly kicks the loose stair-rod for its hostility in tripping him up. Here there is no "*as though*," for that comes later in our development, and by its use we rob this mode of thought of its potentiality of being translated into actions that we have learned from experience to be futile. Besides treating the metaphor or symbol as a reality, there is another primitive trait in the expression of the irrational fear, for in almost all the examples quoted we find that the primary cause of fear lies within ourselves and is, at bottom, a fear of ourselves, which is displaced on to some external object. The operation of projection is a common mental process, more especially among primitive people, and is sufficiently illustrated by the belief that we are more commonly tempted by the devil than by our own wayward instincts.

In the case of fear it has this value, that it provides an outlet by which the fear can in some measure be "worked off," and its attachment to an external object enables the sufferer in neurotic cases to believe that by taking precaution he can escape the fear or safeguard himself against it, but as Burton says¹: "Melancholy men have an inward cause, a perpetual fume and darkness, causing fear, grief, and suspicion, which they carry with them, an object that cannot be removed, but sticks as close as a shadow to a body—and who can expel or overrun his shadow?"

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UNIVERSITY INTELLIGENCE

TRINITY COLLEGE, Cambridge, offers for the second time a Research Studentship, of a value varying with the need of the student but not exceeding £200 a year, to a non-member of the University of Cambridge who proposes to enter that University in October 1922 as a candidate for the degree of Ph.D. Applications should be sent as early as possible in July, and not later than July 25, to the Senior Tutor, who will supply further particulars on request.

¹ In *The Anatomy of Melancholy*, first published in 1621. There is an edition of it in Bohn's Standard Library.

Primitive Architectural Canons

By Arthur Bowes, A.M.I.C.E.

In architecture, as distinct from building construction, the relative proportions of the various parts of a building are an essential factor if it is to embody conceptions of beauty or any suggestions by the use of symbols. Measurement and the adoption of units of measurement thus become necessities in the primeval stages of the art. In the July issue of DISCOVERY, I showed how the Hexapla or Six-pointed Star, the Pythagorean or 3.4.5 triangle, and other simple geometrical figures were largely used in early ages as unitary measures, and how, also, these fundamental figures can still be traced in the design of structures where their presence has been hitherto unsuspected. I offer some further examples here in the hope of inducing more detailed investigations into a subject both wide in extent and historically interesting.

The Hexapla, or Double Triangle or Six-pointed Star, is probably the most ancient of such unitary figures on account of the ease with which it could be constructed. It is based on the aggregation of equilateral triangles, and would be formed in primitive times by the use of three measuring rods of equal length placed end to end. Strings or cords might have been used, as we know definitely that they were used very early in Egyptian civilisation, but the measuring rod is one of the most venerable appliances. It still exists amongst us, if only in name, as the "rod, pole, or perch" of land measure, varying in length from 5½ to 8 yds., while our yard measure and 6-ft. staff are everyday examples.

In setting out the Hexapla on the site of a building, the process would be something like the following. The centre point would be first decided upon, then the triangle ABC formed by placing the rods end to end as in Fig. 1. The rod AC being left in position, AB and BC would be transferred to new positions in order to form the triangle ACD, and so on until the whole figure was completed. The accuracy would be checked by the closing in of the last and first triangles, and also by the prolongation of the lines to the outside points, or "landmarks," indicated by the figures 1, 2, 3, 4, 5, 6. The use of the Hexapla has been so largely dealt with in architectural literature that it will be sufficient here to call attention to some examples not referred to by other writers. In Lincoln Cathedral the vertical section of the south transept is based on three hexagons such as form the central part of the Hexapla. The ground plan of Coningsburgh Castle is obviously a hexagon. In the Rhine Valley

the churches of Trèves, Speyer, and Freiberg have their plans based on either one or two hexagons. It is especially interesting to find, by examination of the plans in Sir E. A. Wallis Budge's handbook of the Nile, that the temples of Karnak, Medinet Habu, and Denderah reveal the same method of planning.¹

The revival of classic architecture gave birth to a multitude of arbitrary rules derived from the study of the finest buildings of Greece and Rome in the hope of emulating their beauty of proportion. Some of these rules, even when divorced from classic design, remained in use until the Victorian age. Thus it was held that beauty of design in any rectangle, such as a window opening or panel, was ensured when the width and length equalled respectively the side and the diagonal of a square, that is to say, were as 1 to 1.414. For simplicity the approximation 7 to 10 was used by the craftsman. The same rule was also applied to the designing of elliptical brick arches over doorways and will be found recommended for this purpose in 1840 in the *Surveyor and Engineer*, a technical journal of the time.

The construction of a right angle by means of a triangle whose sides were in the ratio of 3.4.5 was a process familiar to the "rope stretcher" or surveyor of Egypt, China, and India in the earliest ages, and the influence exercised by this figure on the design of buildings in later times was dealt with at some length in the previous article in DISCOVERY.² Some further examples of its use are now offered, but to show in detail the various methods in which it was applied would necessitate more space for illustrative plans than can well be spared here. The references, then, are intended chiefly as indicating where confirmation of the statements of its use may be found. If the plans of York Minster be examined, it will be seen that three diamonds—each formed from four 3.4.5 triangles with their four right angles in juxtaposition, in the manner formerly described—will fill the width and length of the nave from the west end to the altar, and another half-diamond will complete the length to the east end of the building. In Beverley Minster and, possibly, in Newark Church, the same figure

determines the principal proportions. In the church at Bradford-on-Avon, built by St. Aldhelm in the eighth century, the dimensions of the chancel, according to Sir W. Besant's *London*, are 10 ft. by 13 ft. 2 in. On the supposition that the 3 by 4 rectangle had been the originating figure, it will be seen that a width of 10 ft. should theoretically require a length of $10 + \frac{10}{3}$, or 13 ft. 4 in., being within 2 in. of the recorded length.

A building which is permeated throughout by this root-figure is Magdalen College, Oxford. In the *British Architect* of September 15, 1907, measured elevations will be found, and investigation will show that the pitch of the roofs is based on the use of the 3.4.5 triangle, while the whole façade of the elevation may be divided into rectangles measuring 3 by 4, each rectangle being composed of two 3.4.5 triangles placed "head to tail."

The interior angles of the 3.4.5 triangles are respectively 90°, 53° 8', and 36° 52'. The architect, when preparing

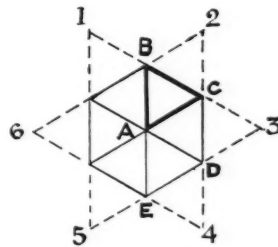


FIG. 1.—SETTING OUT THE HEXAPLA.

his drawings, included among his instruments a set-square made to this shape, and when he wished to design a gable, either at the end of a roof or as an ornamental feature, he made use of such one of the three angles as suited his purpose. Examples of all three uses are plentiful; as an example of the use of the intermediate angle, reference may be made to the measured drawings of a richly decorated sepulchre at All Saints' Church, Hawton, illustrated in the *British Architect* of February 19, 1911. French and Italian architecture of two or three centuries ago exhibit many instances of the same controlling methods.

The most romantic of all discoveries in this connection, and one which lifts the theory into the domain of popular interest, is that which clearly establishes its relation to the Pyramids of Egypt. It is generally supposed that if anything can give weight to the validity of a new idea, whether it relate to the precession of the equinoxes, the squaring of the circle, the chronology of history, the weights and measures of England, or the coinage of America, no argument can surpass the calling in of the Pyramids as witnesses to its truth. Their confirmatory evidence is irresistible

¹ In the previous article in DISCOVERY, the Manchester Free Trade Hall was referred to as having been designed from the proportions of the Vesica Piscis, which is the figure formed by placing two equilateral triangles base to base. By calculation it can be shown that in such a figure the relation of width to length is 1 to 1.732. An example of the use of this proportion in Indian architecture so long ago as 257 B.C. will be found in Mr. E. B. Havell's *Handbook of Indian Art* (John Murray, 1920). On p. 24, in the description of Lomas Rishi Cave, near Gaya, it is stated that the interior hall measures 33 ft. long and 19 ft. wide. These dimensions are in the ratio of 1 to 1.736, a negligible difference.

² Vol. II, No. 19, July 1921.

and conclusive. Let me, then, describe the manner in which this venerable enigma of the builder's lore lurks, unseen by the average eye, in the unchanging lineaments of the Pyramids. For some years I tried

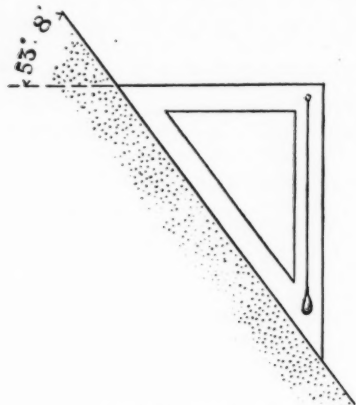


FIG. 2.—A FAVOURITE SLOPE OF PYRAMIDS.

unsuccessfully to find a relation between the slope of the Great Pyramid and any of the angles of the 3.4.5 triangle. Failing in that direction, I directed my attention to some of the others out of the many Egyptian pyramids and met with the following extraordinary result. In the *Encyclopædia Britannica* the slope of the Second Pyramid, that of Kephron, and also of the seventh, eighth, and ninth pyramids, is given as $53^{\circ} 10'$. The discrepancy between the $53^{\circ} 8'$ of the 3.4.5 triangle and this statement of the measurement by engineers is, as a matter of material practice, so small that there seems little reason to doubt that in the building of these pyramids the 3.4.5 triangle was used to regulate the slope of the sides in the manner shown in Fig. 2. The agreement is so close between the theoretical angle and the angle recorded as measured that in the Second Pyramid, whose height is given as 472 ft., the recorded height is within a few inches of the theoretical height. When we take into account the ill-defined surface of the stonework, the instrumental and personal errors, the theory may fairly be regarded as a true explanation.

Even in the Great Pyramid itself, although the slope of the side cannot be made to conform with this theory, there lies a cryptic revelation of the 3.4.5 proportions hidden in the dimensions of the King's Chamber, the very nucleus of the stone immensity.

The dimensions of the King's Chamber are given as 34 by 17 ft., with a height of 19 ft. The floor is a simple oblong, twice as long as it is broad—a figure which has some little interest in itself, yet, in view of what follows, the simplicity of its design might almost be considered as an intentional blind to divert

one from the true secret concealed in the dimensions. The curious relation of width to height, 17 to 19 ft., lacking, so far as I could find, any feature of interest, led me to probe in other directions, and finally I discovered that an imaginary 3.4.5 triangle will exactly fit into the chamber if the 4 side is assumed to lie along the foot of one of the side walls with the opposite angle of the triangle raised until the 5 side forms the solid diagonal of the chamber. The diagram in Fig. 3 will make this clear.

The statement is not an airy creation of fancy. If the measurements, on which the calculations are based, are correct (and there is no reason to doubt their accuracy), then the result is a mathematical certainty. Taking the 34 ft. as representing one side—the 4 side—of the 3.4.5 triangle, the 3 side is the diagonal of the end wall, that is to say, $\sqrt{17^2 + 19^2} = 25.5$. Then, to find the 5 side of the triangle we have $\sqrt{25.5^2 + 34^2} = 42.5$. The three sides of the imaginary triangle are, thus, 25.5, 34, and 42.5. These will all divide by 8.5, and are found to be in the ratio of 3.4.5.

The work of setting out the dimensions in this chamber would have been carried out more easily by cords than by rods. Three of the priestly architects working in solitude, so as to preserve the special knowledge which they alone possessed, would determine the intended height of the chamber by the simultaneous stretching of two cords. Once the height had been determined, the polished red granite blocks forming the walls would have been built up, the roof slabs laid, and the superstructure completed. The treasure buried in the heart of the Great Pyramid was not a hoard of gold or jewels that could be ransacked; it was entirely immaterial; an idea, not a

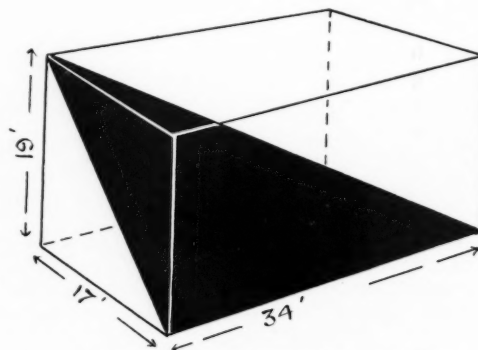


FIG. 3.—THE SECRET OF THE KING'S CHAMBER.

tangible thing; and so it came about that through forty centuries of turmoil and change it rested there an unsolved mystery, the most baffling of all the puzzles in Time's amusing toy-shop.

An Eighteenth-Century Character

(Continued from p. 300, Vol. II, No. 23, and concluded)

By Rowlands Coldicott, M.C., B.Litt.

Peter Pindar's Lyric Odes are difficult to quote: their merit lies in their originality. They read easily, are full of clever similes and audacious criticisms. In them for the first time one finds that mixture of tale, fable, conversation in verse, and comic ode that for many years to come Peter poured forth with such facility. In this early pamphlet occurs the phrase "brother of the brush" which ever since has been in common use among artists. Ode VI contains his rollicking tribute to Wilson the landscape painter—a rare piece of discerning criticism, for Wilson's greatness has only lately been fully recognised. Wolcot says:

"... Till then old red-nos'd Wilson's art
Will hold its empire o'er my heart
By Britain left in poverty to pine.
"But, honest Wilson, never mind;
Immortal praises thou shalt find,
And for a dinner have no cause to fear,—
Thou start'st at my prophetic rhymes:
Don't be impatient for those times
Wait till thou hast been dead a hundred year."

But the pamphlet did not pay its way, and it was not till 1785 that he knew success. Kersley—who a quarter of a century earlier, when Wolcot was a young medical student in London, had stood literary godfather to Churchill—now came to him and made him an offer. The price of the pamphlets increased, first to a shilling, then to half a crown. He began to have imitators. About the middle of the year he struck a vein which was destined to bring him much gold. It was a happy hour for him when he conceived the bold idea of turning the king into a kind of comic figure. Byron came later to give the final damaging blow in his *Vision of Judgement*; it was Wolcot who prepared the way. It is true that there were many others. The wits of the Rolliad, Dr. French Laurence, General Fitzpatrick, Tickell, Richardson, and others were not too scrupulous in their Probationary Odes to point out the private absurdities of George the Third—but no one specialised in him like the man who laughed behind the mask of *Peter Pindar*.

All Wolcot's satires of the monarch can be found in those five volumes of verse, mostly comic, published in 1812—the "works" of *Peter Pindar*. In fable, tale, and ode, even in mock-heroic epic, the farmer-king is systematically "rotted." Did Tom Warton write a birthday ode to him, *Peter Pindar* was ready

to hold it and its royal subject up to ridicule. Did the king stir out of his palace, *Peter Pindar* would scatter broadcast over the town his version of the adventure. His best-known tale—one that found a place in children's books of the last century—the story of the apple-dumplings—relied for its humour on the personal eccentricities of George. His best piece in dialect describes the arrival of the king in Devonshire. Another most amusing tale is the description of the king's visit to Whitbread's Brewery. It occurs as an elaborate piece of by-play in a pamphlet entitled *Instructions to a Celebrated Laureate*. A short quotation will show how extraordinarily clever he was in reproducing the king's peculiarities:

"How did his Majesty so gracious say
To Mister Whitbread, in his flying way,
'Whitbread, d'ye nick th' Excisemen now and then?
'Hae, Whitbread, when d'ye think to leave off trade?
'Hae, what? Miss Whitbread's still a maid, a maid?
'Wha, what's the matter with the men?
"D'ye hunt? hae, hunt? No, no, you are too old.
'You'll be Lord May'r, Lord May'r one day;
'Yes yes, I've heard so; yes, yes, so I'm told:
'Don't don't the *fine* for Sheriff pay;
'I'll prick you every year, man, I declare.
'Yes, Whitbread, yes, yes; you shall be Lord May'r.
"Whitbread, d'ye keep a Coach, or job one, pray?
'Job, job, that's cheapest; yes, that's best, that's best.
'You put your liveries on the *Draymen*, hae?
'Hae, Whitbread, you have feather'd well your nest.
'What, what's the price now, hae, of all your stock?
'But Whitbread, what's o'clock, pray, what's o'clock?
"Now Whitbread inward said, 'May I be curst
'If I know *what* to answer *first*.'"

Wolcot is so well known to students of the end of the eighteenth century as a ribald rhymester who made a living out of being impudent to the king that no one has yet perceived that his works are strewn with vestiges of greatness. Side by side with low tales and cheap knockabout tricks in comic dialogue, similes and illustrations exist that show an immense capacity for observation and a huge stock of varied knowledge. If he described anything, he makes you certain that he has seen it. These illustrations, popping up in his imagination on the slenderest excuse, are worked out with a care worthy of better pages, but appear—such is his art—to have been dashed off with a light and careless hand, as in this passage of the Whitbread tale:

"Reader, didn't ever see a Waterspout?
'Tis possible that thou wilt answer 'No.'
Well, then, he makes a most infernal rout;
Sucks, like an elephant, the waves below,
With huge proboscis reaching from the sky,
As if he meant to drink the Ocean dry.
At length, so full he can't hold one drop more,
He bursts: down rush the waters with a roar
On some poor boat——"

His descriptive methods in this extract are those of Byron in *Don Juan*. Moreover, the movement of the first three lines very nearly resemble many of Byron's. There are passages in Wolcot where, in addition to similarity in speed, movement, and pose, he almost—but not quite—stumbles upon the "Don Juan Stanza." He was, without doubt, a precursor of Byron, and without doubt Byron read him well. It is possible to consider carefully these curious relationships between poets without forgetting for a moment how widely asunder in point of achievement they may be.

Yet Wolcot was, in truth, capable of many things; of an epigram:

"A poet and a kingdom and a cat
Should never never never be too fat."

of enunciating a philosophy:

"Care to our coffin adds a nail, no doubt;
And every Grin, so merry, draws one out.
I own I like to laugh, and hate to sigh
And think that risibility was given
For human happiness, by gracious Heaven!
And that we came not into life to cry;
To wear long faces, just as if our Maker,
The God of Goodness, was an Undertaker,
Well pleased to wrap the Soul's unlucky mien
In Sorrow's dismal crape or bombazeen.

"Methinks I hear the Lord of Nature say,
'Fools, how you plague Me! go, be wise, be gay;
No tortures, penances, your God requires:
Enjoy, be lively, innocent, adore;
And know that Heaven hath not one Angel more
In consequence of groaning Nuns and Friars.
Heaven never took a pleasure or a pride
In starving stomachs, or a horsewhipp'd hide.'"

And now this Ballade shall prove whether Wolcot is not a better writer than scores of poets and rhymers who still receive an absurd amount of attention in histories of English literature:

"BALLADE

"Couldst thou look into myne Hearte,
Thou wouldst see a Mansion drear;
Some old haunted tower aparte,
Where the Spectre bands appear:
Sighing, gliding, ghostly forms,
'Mid the ruin shook by storms.

"Yet my Hearte, whiche love doth slighte,
Was a Palace passing fair;
Which did hold Thyne image bright,
Thee the Queen of Beauty rare;
Which the laughing Pleasures fill'd
And fair Fortune's sunne did gild.

"When shall my poor Hearte, alas,
Pleasure's Palace be again?
That, sweete Mayde, may come to pass
When thou ceasest thy disdaine:
For thy smiles, like beams of day,
Banish Spectre forms away."

That is not an isolated instance. In his "new old ballads" many tuneful songs are to be found, their subject-matter based upon close reading of the Elizabethans. Wolcot was deeply read in English literature: even his earliest Truro Lampoons show that he was well conversant even at that time with Chaucer. Later in life he spoke and wrote strongly about the universal neglect of Shakespeare. His natural bent led him to the study of comic writers, of whom he considered Hudibras the greatest.

After the collected edition of his works was published, Wolcot, now grown old, settled down for the rest of his life in a little cottage in Somers Town, which stood in a gardener's ground called "Montgomery's Nursery." It is now the precincts of Euston Station, but at that time was a rural retreat. Here until the year



GEORGE AND THOMAS WARTON BEING KNOCKED OFF PEGASUS BY WOLCOT'S SATIRE.

A caricature by Rowlandson, illustrating *Ode upon Ode*, by Peter Pindar.

of his death he remained, infirm and blind, but still writing. It is possible to see him distinctly amongst his possessions in these last years. Behind the door, and opposite a broad window that opened to the ground, stood a square piano. On it lay his favourite Cremona violin, which is still preserved in a house in Canada. His armchair faced the fire, the piano was on his right. A landscape by Wilson hung over the mantelpiece and two enamels by Bone. On his shelf was a Shakespeare, second folio. He could still strum the piano and play the fiddle, and even occasionally composed light airs for amusement. When writing verses he generally employed an amanuensis. But he also continued until shortly before his death to write with his own hand, one stanza on each piece of paper. Several of these essays of the old blind poet are in the possession of the present writer.

There is nothing in English literature quite like the burlesque style of Dr. Wolcot. Utterly unscrupulous in

attack, he is able, with satire, invective, irony, and sheer fun at his command, to set before us a feast that both attracts and disgusts. In him literature is expressed in the lowest possible terms, and Life and Death sit subject to the spirit of mockery. To Wolcot must be paid this tribute—that in his best burlesque passages not a word is out of place. He was master of his craft, and though a large quantity of inferior work could be spared from his volumes, his best is in its own way final. This man is not one of your small writers who have only once or twice contrived to express themselves notably; there is in him a careless ease that claims companionship with the great. At times, perhaps in the most unexpected places, there is present in his verse a movement like a heavy ground swell, a grand manner that recalls Dryden, the expression of something pent up, the fervour that makes a style. Often it is mated with words not in themselves expressing remarkable sentiment. The artist is greater than the man.

Wolcot stands confessed in his works, and does not need a final apology. His five volumes of verse are unique in our literature. Even as a mere guide-book to the last quarter of the eighteenth century they are worth more than the few pence demanded by book-shops in the Charing Cross Road. He is also worthy of study as a character, an exceptional human being. Much is known about him. Much remains to be collected.

(Concluded)

BIBLIOGRAPHY

There are numerous editions of Wolcot's works. The best is in five volumes, with a short life, printed in 1812. None is complete. All his pieces were originally published in single quarto pamphlets. The fullest life is that in *Annual Obituary and Biography*, 1820. By far the best article is that in *West Country Stories*, by W. H. Hamilton Rogers, 1895, entitled "The Sweeter Side of Peter Pindar." Among other source books too numerous to list there are:

Polwhele's *Traditions and Recollections* (for the Truro period).
Opie and his Works, by J. Jope Rogers, 1878.
Opie and his Circle, by Ada Earland, 1911. (Hutchinson & Co.)

Past Celebrities, by Cyrus Redding.

Records of My Life, by John Taylor, 1832.

"An Academy Critic of 100 Years Ago," *Magazine of Art*, 1883.

Public Characters, American Edition, 1803.

Crabbe Robinson's Diary sub. 1811 (in MS. at Dr. Williams' Library, Gordon Square—a vivid unfavourable personal sketch).

All the above must be read with caution. References abound in late eighteenth-century reminiscences. See also *Notes and Queries* (2nd Series, vol. vii), early files *Morning Post* newspaper, *Blackwood's Magazine*, July 1868. Much unpublished material is extant, particularly a manuscript life, with portraits and letters, contemporary, compiled by a Mr. Giddy. This is drawn upon in the present article. It does not shed much light on Wolcot's later life. There are manuscripts in the public library, Auckland, New Zealand.

NOTE.—There is an excellent portrait by Opie in the National Portrait Gallery. Also a delightful miniature of Wolcot in his old age, by Cosway. The author would be glad to hear from anyone who has knowledge of manuscript, verses, or letters, or specimens of Wolcot's painting.

Reviews of Books

Forensic Chemistry. By A. LUCAS, O.B.E., F.I.C.
 (Edward Arnold & Co., 16s.)

A forensic chemist is a solver of chemical problems that arise in connection with the administration of justice. He is a man who should combine the qualities of a first-class analyst with those that go to the making of a successful detective; an expert who sits in the office of his laboratory, waiting like Sherlock Holmes for the man in difficulties to ascend the stair.

The author of this work is the director of the Government Analytical Laboratory in Cairo, and his book, as far as the reviewer is aware, is the only one published on this interesting application of chemistry to life. It should appeal not only to students of chemistry, as more or less light reading, but also to that large class in the community, the authors and readers of detective stories.

Forensic chemistry deals not only with purely chemical questions like the nature and composition of any material whose quality may give rise to legal proceedings, but also with the examination of articles for the presence or absence of particular substances such as poisons, or compounds which may have originated an explosion or a fire. It is concerned also with questions which are only partly chemical, such as the examination of blood-stains, finger-marks, documents whose authenticity is questioned, and counterfeit coins.

In each chapter Mr. Lucas gives a careful statement of the problem, and in some, but not excessive, detail the general line of attack upon it. He then quotes from his large experience in Egypt several examples which illustrate and justify the methods employed. Finally, he gives the references to books in which that particular subject may be further pursued.

In the chapter on bullets we have these illustrative cases. A man, who was suspected of wounding another by shooting, escaped conviction because the shot from a cartridge discovered in his home was found by analysis to differ from the shot extracted from the wounded man; the former contained a comparatively large amount of tin, and the latter a trace of antimony, but no tin. In a second case a night watchman shot at some unknown persons suspected to be thieves, who succeeded, however, in getting away. Next morning blood was found on the ground, and later a man was arrested with a shot-wound in his leg for which he was unable to account satisfactorily. The analysis, however, proved that the composition of the lead extracted from the wound differed from that of the slugs in the watchman's cartridge. Both had antimony as an impurity, but the amounts of these impurities differed. The man was consequently released.

In the chapter on clothing we have the following remarkable story. A waistcoat was submitted to a chemical expert with a request for information concerning its owner, who was found near the Suez Canal in suspicious circumstances during the war. The waistcoat appeared almost new, but had a stain in the lining (probably due to per-

spiration) and a bone button bearing the address Batavia and a name, probably that of a tailor. Portions of the waistcoat were soaked in distilled water, and the solutions obtained examined chemically. These contained various compounds of calcium, magnesium, sodium, etc., in about the same proportion as they exist in sea water. It was also concluded that a very fine quartz sand, found in each pocket, was dune sand. The deductions from these facts were as follows:

The owner of the waistcoat had bought a ready-made suit of clothes in Batavia. The stain proved that the lining had been used before, since the stain had not been acquired while the lining was in its existing position. An old lining on a new-looking waistcoat suggested a ready-made suit rather than a second-hand one. The man had travelled to Egypt in a Dutch steamer (the only steamers which then called at Batavia and passed through the Suez Canal). He had left the boat surreptitiously while it was passing through the Canal, and had swum to shore. He had not waded, because the presence of seawater salts even at the top of the waistcoat suggested entire immersion. He had landed from the Canal at a place where there were sand-dunes. This was indicated by the nature of the sand found in the pockets.

These conclusions were subsequently proved to be correct.

One of the most interesting chapters in the book is the account of the methods used in the detection of counterfeit coins. In this particular work the camera and the microscope are particularly valuable adjuncts. The chemist is required not only to analyse the counterfeit coins, but also the materials seized on the premises of suspected persons, which may include metals, moulding composition, and miscellaneous chemicals. It is also part of his job to know the most up-to-date methods and apparatus employed by coiners, as well as the methods employed in minting the genuine article.

In one case, in the house of a man suspected of producing counterfeit coins, were found several pieces of white metal and some similar-looking metal adhering to the end of an iron rod, which had manifestly been used as a stirrer. The defence was that these articles had been used merely for tinning copper saucepans, a common practice. Analysis, however, proved that both the pieces of metal and the metal on the rod were identical in composition with the counterfeit coins, and differed considerably from the material ordinarily employed for tinning saucepans. The man was convicted.

The reader will find especially interesting the chapter on the detection of forgeries in documents, which includes also an account of secret writing and sympathetic inks; also the chapters on poisons, on the preservation of the human body, and on the detection of robbery from letters and parcels.

It is a good book, and very interesting.

A. S. R.

Radio-activity and Radio-active Substances. By J. CHADWICK, M.Sc., Ph.D. (Sir Isaac Pitman, 3s. 6d.)

This, the latest volume of Pitman's Technical Primers series, is the most up-to-date exposition of the physical side of radio-activity in English, and no better book on the

subject could be recommended for the senior class of schools and to university students reading for honours in physics. It is an introduction to the study of radio-active substances and their radiations, the nature of radio-activity, and the bearing of radio-active transformations on the structure of the atom. It follows in the main the lines of Sir Ernest Rutherford's great book, *Radio-active Substances and Their Radiations*, published in 1913, but it is very much shorter, it omits references to authorities, and time has enabled it to include an account of the valuable additions that have been made to the subject during the last eight years. Dr. Chadwick has one advantage over many writers of textbooks—he knows his subject from the inside. This is useful knowledge, for it helps an author to write on occasion a book which is not merely informative, but arresting and stimulating; one, like this one, that is worth buying, reading, and keeping.

The author has included the results of the most recent work on radio-activity in this book. The treatment is simple, concise, and strictly scientific. He bases his exposition on the modern conceptions of atomic structure, and does not pay much attention to the historical order of discovery. This is no doubt wiser and makes for clearness, but a short historical description, if it be genuine, may provide an excellent opportunity for an author to recall to his readers' minds the main facts and theories with which he assumes them to be familiar before he begins his self-appointed task. It would have been a gain, I think, if Dr. Chadwick had led off in Chapter I with a diagram demonstrating the place of the radio-elements in the periodic system, and followed it up with a short description of atomic number.

A. S. R.

Taboo and Genetics. By M. M. KNIGHT, Ph.D., IVA LOWTHER PETERS, Ph.D., PHYLLIS BLANCHARD, Ph.D. (Kegan Paul, Trench, Trubner & Co., Ltd., 10s. 6d.)

This book is a survey for the general reader of the sexual factors that influence the life of the community; it is divided into three sections, a biological, sociological, and psychological, each of which is written by a separate author.

The biological section, by Dr. M. M. Knight, is an elaborate but lucid summary of the more modern work on the biology and physiology of sex, from which the author draws the conclusion that the difference between the sexes is a quantitative one, *i.e.* a question of degree rather than the expression of an absolute qualitative difference.

The sex of the individual is determined at a very early stage by a bias impressed upon the chemical processes of metabolism, a bias that is maintained throughout life by the chemical secretions of the ductless glands; so that the sexual character comes to depend immediately upon the balance of the endocrine or ductless gland system, and if this is disturbed, corresponding changes in the sexual characters will ensue.

From the qualitative nature of the sex differences it follows that considerable variations are found in the degree

of masculinity and femininity of individuals, and it may be said that the pure type, 100 per cent. male or 100 per cent. female, only exists as an abstraction; the author therefore makes a plea on biological grounds for a less rigid and uncompromising view than is usually held of the contrast between the sexes. The greatest distinction, he finds, lies in the structural specialisation of the female for the task of supporting the life of the embryo during its intra-uterine existence, a point that is not very clearly followed up in the rest of the book.

In the second (sociological) section, Dr. Iva Peters gives a complete survey of the taboo of women, that complicated and rigidly enforced code of *things forbidden* by which primitive man limits his association with women or anything connected with them, and so protects himself against the evil influence that he believes to emanate from them. Crawley's theory, that this taboo is designed to protect man from the possibility of being "infected" by the weakness and inferiority of the other sex, is recorded, but no mention is made of his teleological explanation that the taboo serves to maintain the specialised division of labour between men and women, which would be of service to the community in maintaining the high degree of efficiency that is favoured by specialisation. It may be noted that the sexual taboos tend to emphasise and reinforce the difference between the sexes, as though primitive man had at bottom some deep horror of their approximation. The taboo of women is next traced into its development as the fear of witchcraft; then, with the fear sublimated into awe, as the veneration of the sibyl and prophetess; and finally, by what the psychologist would call reaction formation, into the ideal of the pure, spiritual woman, asexual and ethereal, culminating in the virgin goddess.

The author points out that the old sexual taboos are still powerfully operative in modern communities and are responsible for much unhappiness and injustice, but she makes very little attempt to trace the influences of the taboo feeling in its many and particular results, and the only remedy that the author proposes against its evil effects—and she appears to assume, what is not quite justifiable, that all its effects are evil—is the complete sexual education of the young and a more open treatment of sex problems generally. But surely something more than this is required, for the taboos are not mere customs that we have preserved by imitation, but the expression of deep-seated, and for the most part unconscious, mental tendencies, and until the lines along which they affect society have been worked out and become common knowledge, it will be difficult to apply the rational outlook that the author demands to these primitive traits that seem, so disastrously in many cases, to have outlived their usefulness.

In the third section, which is in many ways the most stimulating and original, the book comes directly to the actual problems with which society is faced. Dr. Phyllis Blanchard discusses the disharmonies of sexual life, the unhappy marriages, the preference for celibacy and the vagaries of the sexual impulse, in terms of the individual. She sees that society ignores the variation in degree of

masculinity and femininity that were indicated in the first section, and sets up the ideal of a standard type to which its members must endeavour to conform even at the cost of their individuality.

She shows that the tendency to conform to the rigid standard goes deeper than a desire "to do the right thing," explaining it on the lines, recently set out by Kempf, of a "conditioned reflex"—that is to say, a reflex that is thrown into activity not only by the normal stimulus, but also by objects usually associated with it, objects that may become in time an essential condition for the excitation of the reflex and even become more powerful in arousing it than the normal object. It is, for instance, a matter of common observation that our feelings of affection can be aroused by almost any attributes of the person that we care for, and even when they occur in other people. Our affections become no longer liable to be excited by any sexually pleasing person, but the reflex is only aroused upon the condition that he or she possesses some of the attributes of the person of our choice. Trouble ensues when the individual falls in love with some imagined ideal of manhood or womanhood, created by society or by special factors in the early environment, only to find that the model who has excited their affection does not fulfil the real demands of their personality, for the natural reflex has been "conditioned" by the ideal standard.

The author seems to feel that the choice of a mate is becoming a matter of greater nicety among civilised people because of increasing individualisation, or, rather, the greater need felt by the individual for the free expression of his personality, a change that is naturally more marked in women, for whom new spheres of activity are constantly being opened.

The rigid standards and ideals of society tend to lag behind the needs of the time and make marriage more hazardous and less attractive, so that many men and women frankly question whether it is worth while, or, if they are less reflective, they decide that their failure to conform to the standard ideal indicates some radical shortcoming in themselves which makes marriage an impossibility. But the sexual impulse demands satisfaction, and if the normal channel is closed, it tends to find a vicarious expression, as, for example, in romantic friendships with another of the same sex, or in other less obvious manifestations of wayward affection. A potent source of disharmony is also found in the fact that the maternal and sexual impulses, though united in the model woman, are not always closely correlated, but frequently exist the one without the other; a peculiarity that the author seems to regard as innate, though it seems likely that in many cases it is an acquired and remediable condition, due to the repression of an instinct by some accident of circumstance.

Dr. Blanchard's section is a thoughtful examination of the problems of society, and is warmly recommended to those who find simple explanations of the "unsatisfactoriness" of modern men and women and do not hesitate to print them.

The joint authorship of the book has made it possible to gather together a great amount of specialised informa-

tion and to include the most recent advances in each aspect of the subject, but these advantages are purchased at the cost of obscuring somewhat the relevance of certain of the facts accumulated round the problems under discussion. It is written for the most part in non-technical language, and should prove stimulating reading to anyone with the smallest interest in the sexual problems of to-day. Each chapter contains a useful bibliography.

F. A. H.

SHORTER NOTICES

Examples in Optics. Compiled by T. J. I'A. BROMWICH, Sc.D., F.R.S. (Bowes & Bowes, 2s.)

One hundred and forty-four questions in physical and geometrical optics, set in the Cambridge manner, for honours students of applied mathematics.

A Catalogue of British Scientific and Technical Books. (British Science Guild, 6 John Street, Adelphi, W.C.2, 10s.)

The British Science Guild is a national organisation, founded in 1905, to promote the application of scientific methods to social problems and public affairs. Its latest activity in promoting the use of knowledge, and thereby furthering the development of education, science, and industry, is in producing this catalogue. Its compilers have attempted to make a complete record of scientific and technical books at present in print other than those intended for primary schools and elementary volumes of a like nature. Books at present out of print, and American books even when published also in this country, have been purposely omitted. The volume contains more than six thousand titles, and the particulars given for each book are author's name, title, size of page, number of pages, date of last edition, name of publisher, and current price.

Particular care has been paid to classification, and the compilers very wisely have called in experts in the different branches to assist. At the end of the catalogue is a subject-index, and an index of authors and translators, which serve to make reference quick and easy.

The Making of Reflecting Surfaces. A Discussion by members of the Physical Society of London and the Optical Society held in November 1920. (The Fleetway Press, 5s.)

This pamphlet, copies of which may be obtained from the secretary of the Optical Society at the Imperial College of Science and Technology, consists of a survey of the bibliography of metallic deposition on glass, with papers on the processes of silvering mirrors, reflectors, quartz and glass fibres, and cognate subjects, by H. N. Irving, J. W. French, of Barr & Stroud's, F. Ellerman and H. D. Badcock, of Mount Wilson Observatory, C. R. Davidson, of the Royal Observatory, Greenwich, R. S. Whipple and W. G. Collins, of The Cambridge and Paul Instrument Co., Prof. Chas. Fery, of Paris, F. Simeon, of Messrs. Adam Hilger's, Julius Rheinberg, and J. W. T. Walsh. Following the papers is a report of the general discussion.

Studies in North Africa. By CYRIL FLETCHER GRANT. (Simpkin, Marshall, Hamilton, Kent & Co., Ltd., 8s. 6d.)

This is the abridged edition of a much larger work published in 1912, *'Twixt Sand and Sea*. And it has been excellently abridged too, so that there is not a sentence that does not convey to the reader the atmosphere of or information about the "land of sand and ruin and gold," as Swinburne described it. Mr. Grant has spent many years in North Africa, and speaks with authority on the successive waves of civilisation that have swept through it from the arrival of the Phœnicians in 750 B.C. to that of the French in 1830, and the wonderful ruins that these civilisations have left in their tracks.

We look forward to reading its companion volume that is to appear later. The illustrations are excellent, but we wish that specimens of statuary and mosaic had been included amongst them.

Marvels of the Animal World. By W. S. BERRIDGE, F.Z.S. (Thornton Butterworth, Ltd., 7s. 6d.)

A great deal of fascinating and out-of-the-way knowledge has been gathered into these pages, which are popularly written and well illustrated. Particularly interesting is the chapter on "Poisonous Animals," but the reviewer, after his own experiences, advises no one to read it just before retiring to bed!

Books Received

(Books mentioned in this column may or may not be reviewed in this number, or in a later number.)

AGRICULTURE

Dates and Date Cultivation of the 'Iraq. By V. H. W. DOWSON, Agricultural Directorate of Mesopotamia. (Part I, 10s.; Part II, 5s. Printed and Published for the Agricultural Directorate of Mesopotamia by W. Heffer & Sons, Ltd., Cambridge.)

ARCHÆOLOGY AND ANTHROPOLOGY

A Textbook of Archæology. By PROF. R. A. S. MACALISTER, Litt.D. (Cambridge University Press, 50s.)

The Evolution of Civilization. By JOSEPH MCCABE. (Watts & Co., 2s.)

Annals of Archæology and Anthropology, University of Liverpool. Edited by T. E. PEET. Vol. VIII, Nos. 3-4. (Liverpool University Press and Constable & Co., Ltd., 6s.)

BIOLOGY AND BIOCHEMISTRY

Considérations sur l'Être Vivant. Deuxième Partie. Par CHARLES JANET. (Beauvais: Imprimerie Dumontier et Hagué.)

The Glands regulating Personality. By LOUIS BERMAN, M.D. (The Macmillan Company, New York.)

GEOGRAPHY

Exploration of Air: Out of the World North of Nigeria. By ANGUS BUCHANAN, M.C. (John Murray, 10s.)

The Historical Geography of the Wealden Iron Industry. By M. C. DELANY. (Historico-Geographical Monographs. Benn Bros., Ltd., 4s. 6d.)

A Concise Guide to the Town and University of Cambridge. Originally written by JOHN WILLIS CLARK, M.A., etc. Seventh edition, entirely revised. (Cambridge: Bowes & Bowes, 1s. 9d.)

POLITICS, SOCIOLOGY, ETC.

Foreign Governments at Work. By HERMAN FINER, B.Sc. (Econ.), etc. (Humphrey Milford, Oxford University Press, 2s. 6d.)

Under New Management: A Book for Business Men and Others. By HUGH P. VOWLES, M.I.Mech.E. (George Allen & Unwin, Ltd., 6s.)

PSYCHOLOGY AND PSYCHO-ANALYSIS

Morbid Fears and Compulsions. By PROF. H. W. FRINK, M.D. (Kegan Paul, Trench, Trubner & Co., Ltd., 21s.)

The Psychology of Medicine. By T. W. MITCHELL, M.D. (Methuen & Co., Ltd., 6s.)

The Gate of Remembrance: The Story of the Psychological Experiment which Resulted in the Discovery of the Edgar Chapel at Glastonbury. By F. B. BOND, F.R.I.B.A. Script by JOHN ALLEYNE. Fourth edition with a record of the finding of the Loretto Chapel in 1919. (Oxford: Basil Blackwell, 7s. 6d.)

LITERARY CRITICISM

Literature and Life. By E. B. OSBORN. (Methuen & Co., Ltd., 7s. 6d.)

RELIGION

Theological Education at the Universities. By the REV. PROF. ARTHUR C. HEADLAM, C.H., D.D. (Oxford: Basil Blackwell, 2s.)

The Process of Man's Becoming. By "QUÆSTOR VITÆ." With preface by DAVID GOW. (Duckworth & Co., 8s.)

SCIENCE

The Emission of Electricity from Hot Bodies. By PROF. O. W. RICHARDSON, F.R.S. With Diagrams. Second edition. (Monographs on Physics. Longmans, Green & Co., 16s.)

Applied Electricity. By S. R. ROGET, M.A., etc. (First Books of Science Series. Macmillan & Co., Ltd., 2s. 6d.)

Applied Calculus: An Introductory Textbook. By F. F. P. BISACRE, O.B.E., M.A., etc. (Blackie & Sons, Ltd., 10s. 6d.)

Edinburgh's Place in Scientific Progress: Prepared for the Edinburgh Meeting of the British Association. (W. & R. Chambers, Ltd., 6s.)

CORRECTION

The price of *New Chapters in the History of Greek Literature*, edited by J. U. POWELL and E. A. BARBER, and published by the Clarendon Press, is 10s. 6d., and not 18s. 6d., as mentioned in our December list of "Books Received"

Correspondence

UNEMPLOYMENT

To the Editor of DISCOVERY

SIR,

I have read with interest Professor Knoop's article on the problem of unemployment in your November issue, but I am afraid I do not agree with him. Unemployment is, in my opinion, not the penalty of capitalism and of industrialism. There is no unemployment in Germany and in Belgium. It is principally due to the unreasonableness of organised labour. There cannot be universal over-production. There can only be ill-balanced production. The great business of the world has always been and is still the exchange of goods between town and country. The prices of country goods, of raw materials, of foodstuffs, etc., have fallen disastrously. Grain, copper, rubber, and many other things are below 1914 prices. The raw producers and farmers throughout the world have been vastly impoverished, but organised labour both in England and in the United States refuses to allow the lowering of wages or the speeding up of production, and the result is that the impoverished people throughout the world cannot buy manufactured goods from England and the United States, but buy them from Germany, Belgium, and other countries which produce more cheaply.

There need not be any unemployment in this country. Hundreds of thousands of houses want building and millions are in shocking disrepair. The housing trade and the trades connected with it could give work to a million people, provided that labour was reasonable, and gave a fair day's work for a fair wage. At least 500,000 servants are needed, but they are not obtainable. Meanwhile half a million women are drawing the dole. The Continent has been impoverished by the war, the oversea countries by the fall in prices, and England by over-taxation. Unemployment is due to the fact that labour refuses to cut its coat according to the cloth available. The shops are full of imported goods which Englishmen refuse to produce at prices which the consumer can pay.

What is wanted is not so much the lowering of wages as the speeding up of production. Doubling output means halving labour costs. On an average the American worker produces as much as three English workers.

Yours, etc.

F. ELLIS BARKER.

ALBION LODGE, FORTIS GREEN,

EAST FINCHLEY, N.2.

November 24, 1921.

To the Editor of DISCOVERY

SIR,

The suggestion contained in Mr. McLaggan's letter re unemployment in your December number appears to rest largely on the assumption that it is essentially technical or craft knowledge that is required for the successful carrying on of an industrial enterprise. It

consequently ignores the very important part played by business capacity in the successful conduct of a business undertaking. However efficient a firm may be on the technical side, it will be unsuccessful unless it is able to buy its raw materials at satisfactory prices, and to sell its output on favourable terms.

As small "one-man" undertakings would be unable to avail themselves of the economies of large-scale production—use of machinery, specialisation of labour, etc.—their prospects of becoming firmly established would be very small, even if times were good. When times are bad, their chances of success, even with adequate capital, would be negligible. In almost every case the capital would be lost. The proposal does not strike me as one which either the State, or a bank, would be wise to finance.

With reference to Mr. Ellis Barker's letter, I do not think that the differences between us are really fundamental; he stresses certain aspects of the problem, whereas I attempted to examine it in a more general way.

Absence of unemployment in Germany is to be accounted for by the inflation of the currency adopted there leading to temporary, but highly artificial, trade prosperity. I referred in my article, with disapproval, to this method of stimulating trade. With regard to Belgium, I do not understand Mr. Barker's statement that there is "no unemployment"; according to the official figures in the *Labour Gazette*, 21 per cent. of the members of the Belgian unemployment funds are out of work at the present time. Mr. Barker attributes unemployment in this country principally to our high costs of production, which, in turn, he accounts for by "the unreasonableness of organised labour." I mentioned high cost of production as one of several causes of unemployment, without attempting, however, to express an opinion as to which cause was most important. I am quite prepared to admit that high cost of production is a very important factor in the present situation, though I should hesitate to say that it is the principal cause of unemployment. Nor should I like to attribute high cost of production entirely to "the unreasonableness of organised labour."

Yours, etc.,

DOUGLAS KNOOP.

THE UNIVERSITY OF SHEFFIELD.

December 5, 1921.

CHRISTIAN SCIENCE, AND SUGGESTION AND AUTOSUGGESTION

To the Editor of DISCOVERY

SIR,

In your November issue there appears an article entitled "Suggestion and Autosuggestion," by Robert H. Thouless, M.A., in which he makes a misleading reference to Christian Science.

Christian Science is not a process of suggestion or autosuggestion; formulas are not used in its teaching or practice. Mrs. Eddy, its Discoverer and Founder, certainly makes the statement on p. 421 of *Science and Health with Key to the Scriptures*, "There is no disease,"

because she also declares that "God, Spirit, is all, and there is none beside Him." Christian Science practice is the demonstration of immortal truth over mortal error, which can only be accomplished through having the Mind of Christ, the divine Mind. The human mind is not a factor in Christian Science healing.

Yours, etc.,

CHARLES W. J. TENNANT.

CHRISTIAN SCIENCE COMMITTEE ON PUBLICATION,
TALBOT HOUSE,
ARUNDEL STP ET,
STRAND, W.C.2.

December 1, 1921.

To the Editor of DISCOVERY

SIR,

My reference to Christian Science in my article was concerned with it in its aspect as a therapeutic system, and not with the metaphysical background of that system. I made the assumption that such success as it had in healing was due to its effectiveness as a process of suggestion to persons with a certain type of mind. A Christian Scientist will probably not agree with me in believing that Christian Science healing is purely an effect of suggestion, but that does not justify him in characterising my reference to it as *misleading*.

I am not one of those who hold that positive science certainly has the last word to say on such subjects, so I am willing to admit the theoretical possibility that the Christian Scientist may be right in supposing that there is an element in Christian Science healing which is not suggestion. . . . On the other hand, there is no scientific evidence that this is the case. What we do know is that there is a curative process of suggestion which is sufficient to account for Christian Science cures, that the deliberate use of this process (as at the New Nancy clinic) results in the cure of bodily ailments, and that the theory and practice of Christian Science are such as to put that process into operation amongst persons who accept the initial creed of Christian Science, including the formula (or dogma), "There is no disease." An elementary principle of science and of common sense forbids us to make the unnecessary hypothesis of a supernatural explanation for facts which have a sufficient explanation in known and natural causes.

Mr. Tennant's statement that "the human mind is not a factor in Christian Science healing" is sheer dogmatism. It is natural that Christian Scientists should suppose that it is not the *only* factor. But even that much less absolute statement cannot be accepted by those of us who are not Christian Scientists unless much more cogent evidence is brought forward than the mere unsupported assertion of believers in Christian Science.

Yours, etc.,

R. H. THOULESS.

MANCHESTER.

December 6, 1921.

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